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BOYCOTT OF GERMAN SCIENTIFIC MATERIALS

TWO remarks encountered in the very early war days of 1914 still remain clearly in the present writer's memory and unfortunately have lost none of their significance with the passing years.

At that time there was a large German colony in Manchester whose relations with the rest of the population were quite friendly. The German Consul was "hail fellow well met" with a large circle of acquaintance. The first of the two remarks above mentioned was his eager assurance to the present writer, on one of the few days before England declared war, that "It will be only a short war, Germany just wants some share in the French colonies!"

The second observation was made by a Dutch technologist, discussing the German mentality with some members of the Manchester Chemical Club. He exclaimed: "Zey haf no zychology."

Both these characteristics of the present Nazi regime, their emphasis on the need for colonies and the absence of psychology, have a clear bearing on the consideration of the *Report to the Cambridge and Boston Branch of the American Association of Scientific Workers* which has recently come to hand from Boston.

In the first place the Report draws attention to the fact that the ideology of the Nazis has resulted in the utilisation of science for purposes of enhancing armaments and promulgating racial hatred. These purposes are evident from the appointment of military experts as directors of scientific researches

and the published diatribes concerning Aryan and non-Aryan science and scientists. As a result of the Hitler regime there has been a definite decrease in the quantity and quality of published scientific research in Germany. Many of the leaders in scientific fields have left or have been forced to leave the country.

In consequence of these facts, which have been established after careful investigation by the members of the *Cambridge and Boston Branch of the American Association of Scientific Workers,* the membership of the Association has voted to investigate the possibility of a boycott of German scientific materials as a means of expressing effectively its disapproval of the Nazi attitude towards science and scientists.

In this connection the present economic situation of Germany is first considered in the Report and it is thought that owing to the alleged statement by Hitler, "We must export or die", the loss of export trade in scientific materials might constitute a threat to which serious attention would be paid.

It is possible, however, that the American Committee is still under the influence of the "gold mentality" since all the gold in the world is gravitating to the vaults of the United States. When it is safely interred there, America, as H. G. Wells remarks, may be considered to have won the Gold Standard game. The Committee may thus be liable to exaggerate the importance of the present shortage of gold in Germany. It may be remembered that certain financial pundits foretold an early end to the last war through lack of money to carry it on. Later it was realized that provided a river continues to flow, the abstraction of water from it in one year does not affect the quantity available during the succeeding years.

Consequently in response to similar warnings Hitler is reported to have exclaimed: "The money is here. There will always be money. So long as the German people work, I am not afraid." That their work has resulted in guns rather than butter does not alter the principle involved.

The question of colonies, nevertheless, does raise currency difficulties. The trouble is not that supplies of raw material are unavailable, but that they have to be paid for in the currency of the country controlling the colony or dominion concerned. Hence the need for exports emphasised by Hitler, as a means for obtaining foreign currency.

The importance of an international currency unit as an element in removing one outstanding cause of war is thus evident.

While the importance and desirability of a boycott of German scientific materials may be unreservedly supported, it would seem better therefore to stress other aspects than the merely financial pressure, which in any event may not be as effective as orthodox economists are liable to imagine.

A non-emotional reason for boycott, which would be at the same time effective propaganda, would be the well-founded belief that scientific goods produced under the present conditions in Germany must needs be of inferior quality.

A continued cultivation of a spirit of untruth must have its effects in other spheres than personal or national ethics. If as is

reported, young Nazi students are reluctant to submit to the discipline of the mathematical sciences, it is unlikely that the engineers and artificers of the next generation can be depended upon to turn out trustworthy products whether motors or microscopes. Clearly, the present Nazi Germany is living on the intellectual capital of an older generation. This is confirmed by the reference in the Report to attempts which have been made to return a certain number of Jewish intelligentsia to Germany.

An effective boycott of scientific apparatus and materials should not be as difficult as it was in the war of 1914–18. The alleged superiority of German products is a suggestion fostered by propaganda. Dyes, chemicals, porcelain and glassware of first rate quality have been available in England since the last war. British microscopes, balances, and instruments of precision generally have always held their own.

In the United States the obsession as to the superiority of German goods has lasted longer, not having been exorcised under the stimulus of necessity. There is no doubt that American manufacturers can turn out excellent materials in all spheres as a result of remarkably widespread technical research of the order exemplified in the Mellon Institute Reports. In the latest of these, just to hand, reference is made, *e.g.*, to optical glass.

Here in India there is a great field awaiting development. Beginnings have already been made with chemical balances at Agra, and laboratory fine chemicals in the General and Organic Chemistry Departments at the Indian Institute of Science, and in other academic laboratories. Refractory porcelain is being successfully manufactured on a large scale at the Government Porcelain Works at Bangalore. The construction of electrical instruments of precision, particularly in the field of wireless, is being developed in the Department of Electrical Technology at the Indian Institute of Science. The necessary training for workmen who will be competent to construct instruments of precision is already available on a modest scale under Dr. Parameshwaran at Trivandrum, and under Principal Bence Jones of the Maclagan Engineering College, Lahore, from whom a bulletin on the subject was advertised some time ago by the Industrial Research Bureau.

Great expectations may justly be entertained of the results likely to accrue from the activity of the newly appointed *Board of Scientific and Industrial Research* under the brilliant leadership of Dr. Bhatnagar.

The scientific community of India may therefore confidently and unreservedly support their American colleagues in their resolution to boycott all German scientific material for which duplicates or suitable substitutes can be obtained elsewhere, to give the boycott the widest publicity, and to endeavour by every means to stimulate the production of such material in their own country.

Let it not be said that through lack of energy and enterprise the industrialists and scientists of India have left the doors of their country open to the burglarious entry of predatory powers.

GILBERT J. FOWLER.

A STATISTICAL STUDY OF THE WEIGHTS OF OLD INDIAN PUNCH-MARKED COINS

BY
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THE punch-marks on old silver coins found in India have presented an unsolved riddle which has been attacked by a classification of the *obverse* marks. The efforts of Messrs. Durgā Prasād,[1] Walsh,[2] Allan,[3] in this direction will be valuable to future scholars, but as yet lead to no conclusion. The first two have paid some attention to the reverse marks also, while the third sometimes ignores them; the reason for this partiality to the obverse is that a group of five marks occurs systematically there, while the reverse may be blank or contain from one to sixteen marks.

The most important qualities of the coins in the ancient days were undoubtedly the weight and the composition. The latter has received very little attention, a coin or two being sampled from each new lot. The former is given as a rule, for every coin, but the statistical study of a coin group by weight does not seem to have been attempted.[5] The resulting confusion as to what standard of weight actually existed can be seen by consulting any of the above works; even Rapson[4] found documentary evidence too self-contradictory for use.

For the basis of a preliminary study, I took Walsh's memoir[2] on two Taxila hoards as fundamental. The work is full of oversights and mistakes, as I have shown in a note to be published in the *New Indian Antiquary*. Nevertheless, it is the only sizeable mass of data available to me, and I take all figures from Appendix XI, with the hope that no error of any importance enters into the weighing. Excluding the 33 Long Bar coins which approximate to Persian sigloi, and the 79 minute coins, all the rest, to a total of 1059 coins which seem meant to represent the same amount of metal, average 52·45 grains in weight. The 162 later coins (App. XII) of a single coinage average 52·72 grains. But the standardization of weights was not the same, as is shown by applying the z test to the variances of the two lots.

But even the main hoard of 1059 *kārṣāpaṇa* is not homogeneous. So, I classified them by the number of reverse marks and found the following data, in which the 64 double obverse coins have been omitted.

In Table I n is the number of coins with the number x of reverse marks given at the column head, and m the average weight in grains. One coin in the square 10-reverse mark class has been omitted, because it has a decidedly different history from that of the rest.[6] There exist coins with as many as 16 reverse marks, but counting the number of marks becomes difficult, and the total not tabulated being 15 square coins and 7 round, the table given below will represent substantially the most reliable portion of the data available to us.

It is seen at once that there is a regular drop in average weight with increase in the number of reverse marks. In fact, for the square coins, the linear regression can be fitted accurately enough by eye and is found on calculation to give the formula: $y = 53{\cdot}22 - 0{\cdot}212\,x$, where y is the average weight in grains and x the number of reverse marks. For round coins, the fit is not so good, though still satisfactory, the regression being $y = 53{\cdot}1 - 0{\cdot}214\,x$. That

TABLE I

	x =	0	1	2	3	4	5	6	7	8	9	10
Square	n =	224	128	132	85	64	46	21	25	10	9	8
	m =	53·26	52·93	52·74	52·47	52·53	52·17	52·03	51·67	51·40	51·47	51·01
Round	n =	58	34	29	28	25	10	13	8	9	3	3
	m =	53·35	52·84	52·75	51·90	52·29	51·67	51·82	52·23	51·23	50·10	51·20

is, practically the same line serves for both (Fig. 1).

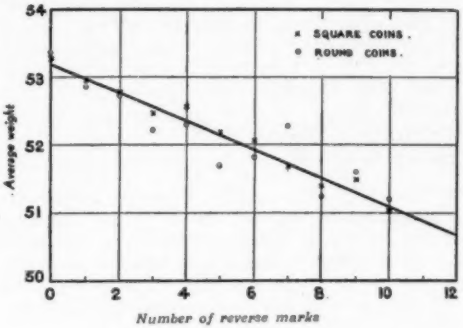

FIG. 1

The second result concerns the number of coins in each group. For simplicity, taking the sum y of both round and square with a given number x of reverse marks, the drop in number is exponential (Fig. 2). That is,

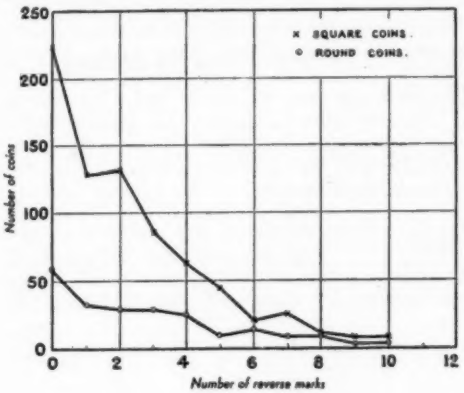

FIG. 2

the regression is given by $y = 283{\cdot}86\, e^{-x/3}$. This was obtained by taking the logarithm of the number of coins with each x, and fitting a linear regression. The divergence between the formula and the observed number is not significant by the χ^2 test, and the calculation obtained from the above table serves also for the omitted coins, giving, for $x = 0$ to 16, a value of χ^2 with P near 0·2; on the whole, a just tolerable fit.

These two results are quite startling. They show that the reverse marks—irregular as they might appear—were not distributed at random, for had they been so distributed, we should have obtained a Poisson distribution or something of the sort for the number of coins as a function of x; and the linear regression for weight would not have fitted so well. The only hypothesis that can account for our results is that *the reverse marks are checking marks stamped on by contemporary regulators or controllers of currency, at regular intervals.*

If accepted, this means that among the obverse marks, there might exist some symbols that specify the date of issue of the coins. This would, possibly, account for the fifth variable symbol found on the obverse. Even now, we have a sixty-year cycle with a name for each year, and there certainly existed an older 12-year cycle, still extant in Chinese and Tibetan tradition, which was converted into a sixty-year affair by associating twelve years with each of the five elements. This could account for one or two of the five obverse marks. One obverse mark is fixed: the sun symbol. If it is not votive, it might be a symbol of the metal itself. The next commonest mark is some form of the wheel, with (usually) six points of varying design. This *ṣaḍaracakra* is, in my opinion, not to be interpreted as a symbol of any deity, but as representative of the issuing authority, the *cakravartin* or king. The form of the points of the wheel, with perhaps one of the extra symbols, might be the ruler's personal monogram. This is borne out by the fact that in the few cases where the six-pointed wheel does not occur, we invariably get (with two exceptions) small homo-signs in their place (Durgā Prasād,[1] p. 41). That is, when the issue was not authorised by a king, it was authorised by a council of some sort.

Leaving these doubtful conjectures, we can use groupings by obverse marks for the purpose of weight analysis and compatibility tests, in particular the t test and the z test. I shall publish my results on this elsewhere.

Even in modern times, a certain amount of currency will be lost each year due to damage, hoarding, melting down, etc. This should, in stable times, be proportional to the actual number of coins in circulation. But when the coin does not represent full value in metal content, being just a token coin, with a rigorous control of weight by the examiners of currency, the formula for the number of coins surviving t years after issue would be given by

$$y = a\, e^{-bt}\left(\frac{1}{\sigma\sqrt{2\pi}}\int_{m_1-r}^{m_1+r} e^{-\frac{(x-m)^2}{2\sigma^2}}\, dx\right)$$

where: $m = m_1 - tm_2$

$\sigma^2 = \sigma_1^2 + t\sigma_2^2$

Here, a is a constant of integration, essentially the number minted. The legal weight, as also the average of freshly minted coins is taken as m_1, the variance at the mint as σ_1^2. The average loss of weight per year is m_2, and the variance of this annual loss, σ_2^2. The legal remedy, i.e., the weight by which a coin may exceed or fall below the legal standard is called r in the formula.

When the coin is a source of metal, the first factor would account for most of the currency in circulation, particularly as the variances with modern technique of minting are very small. But with a token coin, and in any case after the passage of a greater number of years, the second factor would begin to dominate, and the coins withdrawn rapidly from circulation by those who check the currency. The phenomenon is similar to that often seen in biology, where a gene or culture of bacteria shows exponential *growth* till a threshold value is reached, when the situation changes entirely, the growth makes its own surroundings lethal, and further growth is either inhibited, or the whole of the variate vanishes altogether.

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[1] *Journal and Proceedings of the Asiatic Society of Bengal*, New Series, 1934, **30**, Numismatic Number.

[2] *Memoirs of the Archæological Survey of India*, 1939, No. 59.

[3] *Catalogue of Indian Coins in the British Museum*, Ancient India, 1930.

[4] *Ibid.*, Andhras, W. Kṣatrapas, 1908, p. clxxvii *et sec.*

[5] The work of A. S. Hemmy, *Journal of the Royal Asiatic Society*, 1937, pp. 1–26 must be dismissed as mere trifling with an important subject.

[6] One coin in the 3-mark round lot should also have been so omitted, bringing the mean to 52·20, which would have fitted much better.

SULPHANILAMIDE AND DERIVATIVES IN BACTERIAL INFECTIONS

BY

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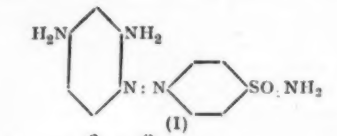
1. Prontosil and Related Dyes

DOMAGK'S sensational discovery[1] of the specific curative effect of 'prontosil' (I) in experimental β-hæmolytic streptococcal infections in mice, which is hailed as the "greatest discovery in modern therapeutics", appears to have been made in 1932 as a culmination of his researches dating from 1923–24 in the Elberfeld laboratories of the I. G. Farbenindustrie.[2] Regarding the hosts of compounds that must have been tested systematically in the course of this investigation, we are given no details. The discovery was announced on the 15th February 1935[1] only after it was confirmed by three years of clinical trials at the hands of the Rhineland practitioners, for "by untimely publication he did not want to give false hopes to doctors and patients".[2] This dye (prontosil) being of low solubility in water (about 0·25 per cent.), a more soluble form, "prontosil soluble" ("prontosil S", "neoprontosil", II) was introduced (as 2·5 per cent aqueous solution) for parenteral use, while in France, a carboxyl derivative of prontosil, "rubiazol" ("rubiazol C", III), synthesised by Gley and Girard[3] came into use.



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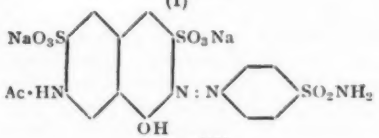

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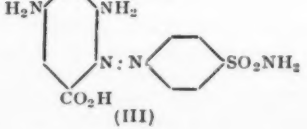


(III)

2. Reduction of Prontosil *in vivo*: Evolution of Sulphanilamide

The next great advance in the subject was made by Tréfouël (J. and Mme.), Nitti and Bovet[4] in November 1935. They studied systematically the antistreptococcal properties of forty-five dyes of the azobenzene group[5] with various substituents and found that the replacement of the sulphonamide ($-SO_2NH_2$) group in prontosil (I) by $-AsO_3H_2$, $-SO_3H$, $-CN$, $-CONH_2$, $-CH_2.CO.CN$ and $-O.Ph$ groups destroyed the activity, while the amino group could be replaced by other groupings without much loss of activity. This led them to formulate the important hypothesis[4] that the therapeutic activity of prontosil is due to *para* aminobenzene-sulphonamide (sulphanilamide) liberated *in vivo* by reduction. In support of this they showed, for the first time, that the simple colourless compound, sulphanilamide (already synthesised by Gelmo in 1908 who never dreamt of its therapeutic properties), itself was as active as prontosil in experimental streptococcal infections. The above results were confirmed from various points of view by many workers. As an apparent proof of the hypothesis, Fuller[6] actually isolated sulphanilamide from the urine of a patient treated with prontosil. Ganapathi and Rao[7] have shown that following the feeding of six typical dyes of this group to groups of mice in therapeutic doses (10 mg.), only the therapeutically active once produce considerable blood concentrations (1·6 to 2·0 mg. per cent.) of sulphanilamide, whereas the very little active or inactive ones produce only traces.

Though till now about seventy dyes of the above group constituting various types have been reported, only a dozen of these have been found to be comparable in antistreptococcal activity to prontosil or sulphanilamide; it is yet to be shown definitely that these active dyes possess any advantage over the parent amines. As regards both the intensity as well as the poly-valency of therapeutic effect, the dyes are inferior to the free amines. For example, sulphanilamide shows a striking therapeutic effect in (β-hæmolytic) streptococcal, meningococcal, gonococcal, bacillus welchi and *B. coli* infections; its effect in B. typhosus infection is considerable; in pneumococcal infections, the protection is less and in staphylococcal infections far less. The dyes show considerable therapeutic effect in streptococcal infections and in the rest their efficacy compared to sulphanilamide is negligible. However, both the dyes and sulphanilamide possess considerable protective effect in the virus infection, lymphogranuloma inguinale.[8]

3. Seat of Therapeutic Activity in Sulphanilamide

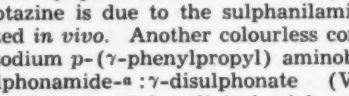
The next obvious step of elucidating the seat of chemotherapeutic activity in sulphanilamide was immediately taken up by Fourneau, Trefouels, Nitti and Bovet.[9] They studied 130 derivatives of related structures[5] and showed that for the antistreptococcal activity, (*i*) the amino and sulphonamido groups in the *para* positions of the benzene ring are necessary, (*ii*) the presence of an additional grouping in the benzene ring destroys the activity and (*iii*) the substitutions in the amino and sulphonamido radicals have variable activity depending on the nature of the substituents. These important findings led to such intense activity in the synthesis of new compounds of this group that, till now, about ninety papers have been published and forty patents taken, reporting in all about 600–700 compounds (besides a lot unpublished).

4. Compounds with Substituents in the Amino Radical of Sulphanilamide

About 130 derivatives with various types of substituents in the amino radical of sulphanilamide have been reported, of which only about twenty possess anti-streptococcal activity comparable to that of sulphanilamide. Of these twenty derivatives, fourteen are Schiff's bases obtained by condensing sulphanilamide with variously substituted benzaldehydes.[10,11] Of the forty-five acyl derivatives reported,[5,12,13,14] the valeryl, caproyl,[12,13] and pyrrolidone carboxy derivatives[10] are as active as sulphanilamide. It is conceivable that all the above compounds can yield free sulphanilamide *in vivo* by hydrolysis. The guanidine[15] and formaldehyde sulphoxylate derivatives[16] of sulphanilamide are stated to be quite active.

4-Benzylaminobenzene sulphanamide (IV) first reported by Goissedet *et al*,[11] and introduced for clinical trials (under the trade names "proseptasine", "septazine"), has been shown to be inferior to sulphanilamide in experimented infections in mice.[10,16,17,18] It has been suggested by Lockwood and Robinson,[18] though it cannot be considered to be

definitely proved, that the activity of proseptazine is due to the sulphanilamide liberated *in vivo*. Another colourless compound, disodium *p*-(γ-phenylpropyl) aminobenzenesulphonamide-$^{\alpha}$:γ-disulphonate (V), has been introduced for clinical trials under the trade name "soluseptazine" for parenteral use. The only animal experiments reported about it by Whitby,[17] do not indicate it to be superior to sulphanilamide. Though these



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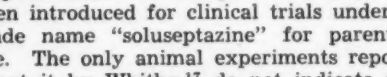


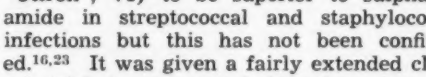
(V)

two drugs possess considerable antistreptococcal action, their therapeutic effects in other bacterial infections compared to sulphanilamide is negligible.[16,17] Schutz[19] has reported "soluseptazine" to protect rats and not mice in experimental P. pestis infections.

The *para* nitro, nitroso, hydroxylamino and hydrazo derivatives of benzenesulphonamide have been studied by Mayer.[20] The first two compounds are more active than sulphanilamide and more toxic, while the hydrazo derivative is inactive. The hydroxylamine derivative is about 100 times more bactericidal than sulphanilamide *in vitro*, but not *in vivo* (this being due to its reduction in the body to sulphanilamide). Some significance is attached to this compound in explaining the mechanism of action and also some of the toxic manifestations of sulphanilamide.[20,21]

5. Compounds with Substituents in the Sulphonamide Radical of Sulphanilamide

Forty derivatives with alkyl and aralkyl groupings substituted in the sulphonamide radical of sulphanilamide have been synthesised and tested but these have proved to be of no advantage. Of interest is the report of Adams *et al.*[13] that five derivatives with hydroxypropyl substituents in the sulphonamide radical show striking antimeningococcal but no antistreptococcal activity. Eighty-five derivatives of 4-aminobenzenesulphonanilide with various substituents in the second benzene ring have been synthesised and tested. Those with the nitro, amino, sulphonamido, substituted sulphonamido, N^1-sulphanilamido, sulphonic and carboxylic acid groupings in the second benzene ring are quite active and many reported to be even superior to sulphanilamide in antistreptococcal activity. Domagk reported[22] *p*-aminobenzenesulphonamido benzene-*p*'-dimethylsulphonamide (known by the trade names, "Deseptal A", "Uleron", "Uliron", VI) to be superior to sulphanilamide in streptococcal and staphylococcal infections but this has not been confirmed.[16,23] It was given a fairly extended clinical trial in gonococcal infections but has now been withdrawn due to the toxic reaction of peripheral neuritis. A series of N^1-acyl derivatives of sulphanilamide has been reported.[24] The acetyl derivative ("albucid", VII), though far less active than sulphanilamide in streptococcal infections, has been introduced for clinical trials in gonococcal infections with the claim that it is of low toxicity and very little of it gets acetylated *in vivo*. Crossley *et al.*[25] have reported five compounds of the disulphanilamide group (VIII) to be superior to sulphanilamide in antistreptococcal action.



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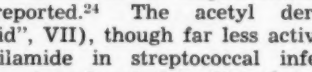

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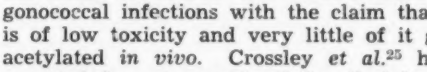


(VIII)

One of these, the sodium salt of disulphanilamide (VIII, R = Na), is claimed to protect mice infected with moderate doses of the influenza virus.[26] Adams, Long and Johanson[13] have reported thirty compounds with acyl substituents in the amino, and hydroxyalkyl substituents in the sulphonamido radicals of sulphanilamide. Of these, only eight are of interest for they are quite active in meningococcal but almost inactive in streptococcal infections.

6. Diphenylsulphone and Related Derivatives

Almost simultaneously, Buttle *et al.* in May 1937,[27] and Fourneau, *et al.*[28] In June–July of the same year reported the remarkably high antistreptococcal action of 4:4'-diaminodiphenylsulphone. This diamine,

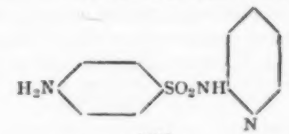
according to Buttle *et al.*[27] is about 100 times as active as sulphanilamide and 10 times more toxic in mice. In rabbits and monkeys, and possibly in man also, the toxicity as also the activity, do not appear to be so high. The diacetyl derivative (marked under the name "Rhodilone" in France for use particularly in gonorrhea) is relatively very little toxic and yet ten times as active as sulphanilamide. The 4 : 4'-dinitrodiphenyl sulphon is as active as sulphanilamide. The last two sulphone derivatives appear to be converted *in vivo* into the free amines.[29] The significance about these compounds is: (*i*) they do not contain the sulphonamide grouping and (*ii*) they are the best of the till then known compounds giving a definite percentage of survivors in experimental pneumococcal (type I) infections. In other types of pneumococcal infections, the action of the diacetylamino derivative is not so good.[30] In experimental typhoid infections, it is inferior to sulphanilamide. About fifty related derivatives of this diphenylsulphone group have been tested but only the benzylidene, glucose[31] and the formaldehyde-sulphoxylate derivatives[32] of 4 : 4'-diaminodiphenylsulphone have been suggested to be of some advantage. However these are not in use in practical therapy to-day.

About seventy related derivatives of the diphenylsulphoxide, diphenylsulphide, diphenyldisulphide and related compounds have been studied but they are generally of far less activity. 4-Nitro-4'-amino diphenylsulphoxide has been claimed by Levaditi *et al.*[33] to possess such specific effects in gonococcal infections as the arsenicals in the spirochætal infections.

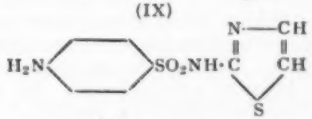
7. Heterocyclic Derivatives of Sulphanilamide

The discovery by Whitby,[34] announced in May 1938, of the remarkable protective effect of 2-N^1-sulphanilamidopyridine ("Sulphapyridine", "Dagenan", "M. & B 693," IX), one of the forty-six compounds synthesised by Ewins and Phillips of the firm, 'May and Baker', in experimental pneumococcal infections in mice, is indeed a distinct advance in the chemotherapy of bacterial infections. The "dramatic cures" obtained with it in clinical trials in cases of pneumonia, have convinced us about its remarkable therapeutic properties. This compound is more polyvalent in action than sulphanilamide. The only experimental infection in which it is shown to be inferior to sulphanilamide is that due to B. typhosus; in streptococcal, meningococcal and gonococcal infections it is at least as good as sulphanilamide, while it is distinctly superior to sulphanilamide in pneumococcal, staphylococcal and P. pestis[19,43] infections.

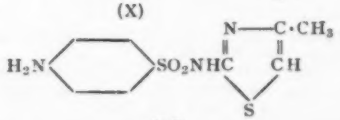
Of the hundreds of aromatic sulphur compounds synthesised and tested, though about seventy are about as active as and twenty-five distinctly superior to sulphanilamide in experimental streptococcal infections in mice, only sulphanilamidopyridine (IX) reigned supreme in its effect in pneumococcal infections. The presence of the heterocyclic ring in this compound gave thus the impetus to search for active compounds among the related heterocyclic derivatives of sulphanilamide. Thus, pyridine, quinoline, acridine, morpholine, piperidine derivatives are being tried. Though the trial cannot be said as yet to be complete, the quinoline, morpholine and piperidine derivatives do not show any promise. The search has been amply rewarded when attention was directed towards the thiazol derivatives by four groups of workers independently—by Fosbinder and Walter,[36] Iuda, Itikawa and So,[37] Lott and Bergeim[38] and Ganapathi and Nandi.[39] 2-N^1-sulphanilamidothiazol (X) and the methyl derivative (XI) have been found to be as active as sulphanilamidopyridine (IX)[40,41,42,45] in pneumococcal infections.



(IX)



(X)



(XI)

Extensive researches with this thiazol derivative (X) (for which the short name "sulfathiazol" has been suggested[40]) at this Institute for the past several months, have convinced us that this new drug has a great future. While being far less toxic, it is even more polyvalent in action than sulphanilamidopyridine. In experimental strepto-

coccal infections in mice it is distinctly superior to sulphanilamide.[42] Sokhey and Dikshit[43] have found that it is far superior to sulphanilamidopyridine and almost a specific in experimental plague infections in mice. In staphylococcal infections also, these thiazol derivatives (X and XI) are distinctly superior to sulphanilamidopyridine. While the animal experiments are very encouraging, only extended trials have to pass the final verdict. In the meantime, similar heterocyclic derivatives are being prepared by the author and tested with the hope of obtaining even better compounds.

8. The Future of Bacterial Chemotherapy

Whatever be the future of "prontosil", which has brought about a renaissance in the Chemotherapy of Bacterial Infections, Domagk has indeed earned a place next to Ehrlich. The evolution of this subject, still in the cradle, from "prontosil" to "sulfathiazol" indicates that we are in the right way towards the conquest of the bacterial infections. The results obtained so far give us even the optimism that some day the dream of Ehrlich of *"a therapia magna sterilisans"*, will materialise at least in the treatment of some bacterial infections. There are many favourable indications for this, *e.g.*, in experimental meningococcal and B. typhosus infections in mice, sulphanilamide can give sufficiently high protection with even one dose of the drug. The achievements so far made are by themselves no means meagre. While Ehrlich met with "one moment" of success after seven years of disappointments, in the present case, in five years have been made conquests of a variety of deadly infections due to at least five types of bacteria. With far more extended trials, we can hope to conquer even the dreaded tuberculosis and detested leprosy.

---

[1] Domagk, G., *Deut. med. Wschr.*, 1935, **61**, 250; *Angew. Chem.*, 1935, **48**, 657.
[2] —, *Zentr. Bakt. Parasit. Krankheit.*, 1939, **144**, 206.
[3] Gley, P., and Girard, A., *Presse. Med.*, 1936, **44**, 1775, *C.R. Soc. Biol.*, 1937, **125**, 1027.
[4] Tréfouël (J. and Mme.), Nitti, F, and Bovet, D. *Ibid.*, 1935, **120**, 756.
[5] Idem, *Annales Inst. Pasteur*, Paris, 1937, **58**, 30.
[6] Fuller, A. T., *Lancet*, 1937, **1**, 194.
[7] Ganapathi, K., and Sanjeeva Rao, R., *Indian J. Med. Res.*, under publication.
[8] Levaditi, C., *C.R. Soc. Biol.*, 1938, **128**, 138, 875.
—, Vaisman, A., and Reine, L., *Ibid.*, 1939, **131**, 40.
Mac Collum and Findlay, G. M., *Lancet*, 1938, **2**, 136.
[9] Forneau, E., Tréfouël (J. and Mme.), Nitti, F., and Bovet, D., *C.R. Soc. Biol.*, 1936, **122**, 258.
[10] Gray, W., Buttle, G. A. H., and Stephenson, D., *Biochem. J.*, 1937, **31**, 724.
[11] Goissedet, P., Despois, R., Gailliot, O., and Mayer R., *C.R. Soc. Biol.*, 1936, **121**, 1082.
[12] Miller, E., Rock H. J., and Moore, M. L., *J. Amer. Chem. Soc.* 1939, **61**, 1198.
[13] Adams, R., Long, P. N., and Johanson, A. J., *Ibid.*, p. 2342.
[14] I. G. F. Patent, *C.A.*, 1938, **32**, 2958 (Indian Patent, 24441).
[15] Buttle, G. A. H., Dewing T., Foster, G. E., Gray, W. H., Smith, S., and Stephenson, D., *Biochem. J.*, 1938, **32**, 1101.
[16] Feinstone, W. H., Bliss, E. A., Ott, E., and Long, P. H., *Bull. John Hop. Hosp.*, 1938, **62**, 565.
[17] Whitby, L. E. H., *Lancet*, 1937, **i**, 1517.
[18] Lockwood, J. S., and Robinson, H. J., *J. Pharm. Exp. Ther.*, 1940, **68**, 201.
[19] Schütz, H., *Lancet*, 1939, **1**, 266.
[20] Mayer, R. L., *Bull. L'Acad. Med.*, 1937, **117**, 727; *Biol. Med.* (Supplement), 1937, **27**, 74.
[21] Schaffer, P. A., *Science*, 1939, **89**, 547; Locke, A., and Mellon, R. R., *Ibid.*, p. 231.
[22] Domagk, G., *Klin Wschr.*, 1937, **16**, 1412.
[23] Mellon, R. R., Shinn, L. E., and McBroom, J., *Proc. Soc. Exp. Biol. Med.*, 1937, **37**, 563.
[24] Crossley, M. L., Northey, E. H., and Hultquist, M. H., *J. Amer. Chem. Soc.*, 1939, **61**, 2950.
[25] Idem, *Ibid.*, 1938, **60**, 2222.
[26] Clemenko, D. R., Crossley, M. L., and Northey, E. A., *J. Pharm. Exp. Ther.*, 1939, **67**, 201.
[27] Buttle, G. A. H., Stephenson, D., Smith, S., Dewing, T., and Foster, G. E., *Lancet*, 1937, **1**, 1331.
[28] Fourneau, E., Tréfouël, J., Nitti, F., Bovet, D., and and Tréfouël (Mme.), *C.R. Acad. Sci.*, Paris, 1937, **204**, 1763; 1937, **205**, 299.
[29] Bovet, D., Tréfouël (J. and Mme.), Nitti, F., and Hamon, M. V., *Annals. Inst. Pasteur*, Paris, 1938, **61**, 812.
[30] Cooper, F. B., Gross, P., and Lewis, M., *Amer. J. Med. Sci.*, 1938, **196**, 343; 1939, **197**, 609.
[31] Buttle, G. A. H., Dewing, J., Foster, G. E., Gray, W. H. Smith, Sand Stephenson, D., *Biochem. J.*, 1938, **32**, 1101.
[32] Bauer, H., *J. Amer. Chem. Soc.*, 1939, **61**, 617.
— and Rosenthal, S. M., *U. S. Pub. Hlth. Rep.*, 1938, **53**, 40.
[33] Levaditi, C., Girard, A., Vaisman, A., Ray and Richard, *C.R. Acad. Sci.*, 1937, **205**, 1018.
[34] Whitby, L. E. H., *Lancet*, 1938, **1**, 1210.
[35] Powell, H. M., and Chen, K. K., *J. Pharm. Exp. Ther.*, 1939, **67**, 69.
[36] Fosbinder, R. J., and Walter, W. A., *J. Amer. Chem. Soc.*, 1939, **61**, 2032.
[37] Iuda, K., Itikawa, Z., and So, D., *J. Pharm. Soc. Japan*, 1939, **59**, 213; *C.A.*, 1939, **33**, 820.
[38] Lott, W. A., and Bergeim, F. H., *J. Amer. Chem. Soc.*, 1939, **61**, 3593.
[39] Ganapathi, K., and Nandi B. K. *Curr. Sci.*, 1940, **9**, 67.
[40] Cooper, F. B., Gross, P. and Lewis, P., *Proc. Soc., Exp. Biol. Med.*, 1939, **42**, 421.
[41] McKee, C. M., Rake, G., Greep, R. O., and Van Dyke, H. B., *Ibid.*, p. 417.
[42] Ganapathi, K., *Indian J. Med. Res.*, 1940, **27**, 971.
[43] Sokhey, S. S., and Dikshit, B. B., *Curr. Sci.*, 1940, **9**, 116; *Lancet* (under publication).
[44] Barlow, O. W., and Homburger, E., *Proc. Soc. Exp. Biol. Med.*, 1940, **42**, 792.
[45] Ganapathi, K., *Proc. Ind. Acad. Sci.*, 1940, **11**, 298.

LETTERS TO THE EDITOR

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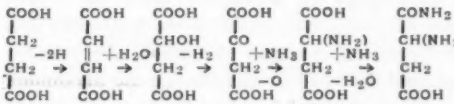
Succinic Dehydrogenase in Germinating Seeds

Although asparagine occupies a central position in the amino-acid metabolism of plants little is known about the mechanism of its formation. On chemical grounds and from analogies based upon amino-acid synthesis in animal tissues it has been considered probable that the asparagine arises from succinic acid (frequently shown to be present in plants) and ammonia (arising from the deamination of amino-acids) by the following reactions (Kostytschew,[1] Chibnall[2]).



A serious difficulty in accepting this scheme has been the fact that succinic dehydrogenase, the enzyme necessary for catalysing the first step in the above chain of reactions, has hitherto not been found to be of general or wide distribution in the vegetable kingdom. In fact Thunberg to whom we owe the demonstration of the existence of many plant dehydrogenases, found the occurrence of this enzyme to be limited to the seeds of *Phaseolus vulgaris*.

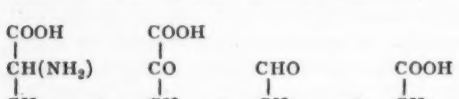
As the most marked accumulation of asparagine takes place in germinating seeds, we have examined the seedlings of a number of species for succinic dehydrogenase using the Thunberg Methylene Blue technique. It was found that seedlings of six species of Leguminosæ tested (*Phaseolus mungo, Phaseolus radiatus, Dolichos biflorus, Dolichos lablab, Cicer arietinum, Vigna catjang*) all show dehydrogenase activity towards succinic acid. The enzyme was on the other hand found to be absent from the seedlings of water-melon (*Citrullus vulgaris*) and rice (*Oryza sativa*). The seedlings were ground in a granite mortar with M/15 phosphate buffer (pH 9·0), pressed through muslin and centrifuged. The supernatant liquid (which was found to contain all the activity) was used for experiment, the reaction mixture being made up of 0·5 ml. of enzyme solution, 0·5 ml.

of N/10 sodium succinate, 0·3 ml. of M/400 methylene blue and 2 ml. of phosphate buffer (pH 7·8). In each case the tests were carried out till the seedling was 4 days old. The results in Table I of an experiment with *Phaseolus mungo* are typical of those obtained in several experiments with the Leguminosæ. Pronounced dehydrogenase activity was always found during the second and third days of germination, the activity afterwards decreasing rapidly.

TABLE I

Age of seedling (days)	Time of decolorisation of Me. Blue (Minutes)	
	Experiment	Control
1	26·0	29
2	3·5	9
3	8·0	16
4	36·0	42

The present findings taken in conjunction with the previously demonstrated presence of glutamic acid dehydrogenase (Damodaran and Nair,[3,4]) make it probable that in the Leguminosæ the accumulation of asparagine during germination might take place at the expense of glutamic acid, succinic acid being formed from the latter by the following reactions:



This is in keeping with the well-established fact that asparagine accumulation is accompanied by a decrease in the other amino-acids, the chief of which (in a quantitative sense) in most seed proteins is glutamic acid.

The explanation for the absence of succinic dehydrogenase in water-melon and rice seedlings might probably be that these plants belong to the type which elaborate glutamine in place of asparagine.

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University Biochemical Laboratory,
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June 19, 1940.

[1] Kostytschew, *Lehrbuch der Pflanzenphysiologie*, 1926, (Berlin).

[2] Chibnall, *Protein Metabolism in Plants*, 1939, (Yale University).

[3] Damodaran and Nair, *Curr. Sci.*, 1936, **5**, 134.

[4] — —, *Biochem. J.*, 1938, **32**, 1064.

Vitamin C Content of Germinated Cereals

THE Vitamin C content of pulses, particularly on germination, has been reported by a number of workers. So far as we are aware, no studies are reported on the Vitamin C value of cereals after germination. The common cereals such as Wheat, Maize, Bajra, Jowar and Rice, which are much cheaper than pulses, have now been examined for their ascorbic acid value, employing a large number of samples under different conditions. Table I gives the average values obtained by the chemical method.[1]

The results show that germinated cereals form a good source of ascorbic acid. The increase in ascorbic acid is of the same order as observed in the case of leguminous seeds.[2] The rate of germination is found to be different in different cereals. Usually the Vitamin C content keeps on increasing until the leaves open out well, after which there is a slight fall in Vitamin C content. In most cases, under the conditions of our experiments the maximum yield was observed between 72–96 hours except in rice and maize which germinated very slowly. The maximum yield was obtained in the case of Bajra, 23·8 mg. per 100 g. after 96 hours of germination. This cereal is the cheapest of all those examined by us. After germination, these cereals can be used either as ordinary vegetables, or they can be ground and the watery

TABLE I

Mg. per 100 grams

Name of cereal	Dry seeds	After germination for :					Remarks
		24 hrs.	48 hrs.	72 hrs.	96 hrs.	120 hrs.	
1. Wheat *(Triticum vulgare)* ..	2·6	3·1	8·8	9·7	15·0	9·15	Slow growth
2. Maize *(Zea mays)*	2·1	3·1	8·7	12·0	10·5	..	,,
3. Rice *(Oryza sativa)* ..	2·4	2·6	3·2	3·9	5·12	8·5	,,
4. Bajra *(Pennisetum typhoide* Rich.) ..	2·6	4·2	14·3	17·6	23·8	..	Good growth
5. Jowar *(Sorghum vulgare* Pers.) ..	1·96	3·4	10·6	11·5	15·8	..	Fair growth

extract taken as a drink with a small amount of salt or sugar.

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June 8, 1940.

[1] Ahmad, *Biochem. J.*, 1935, **29**, 275.
[2] —, *Ind. J. Med. Res.*, 1935, **22**, 789.

The Available Substrates in a Developing Fruit and Their Behaviour in Storage

A STUDY of the nature and the concentration of the substrates during the life-cycle of the fruit and their behaviour under different conditions of storage are of fundamental importance for a better handling of the storage problem. Such a study is particularly important in the case of Indian fruits which are exposed to the uncertain climatic conditions of the tropics.

From these standpoints, the behaviour of the available substrates in *Mangifera indica* with reference to storage and the effect of ethylene gas on them as a means of artificial ripening, were reported previously.[1] The results obtained in the case of another fruit *Pisidium guavæ* are briefly reported here.

The changes in the substrate concentration in the fruit growing in the tree are briefly summarised in Table I.

TABLE I

Fruits on the Tree

Substrates	Pickings from the same tree			
	Early Stage	Enlarging Stage	Maturity Stage	Senescence Stage
1. Protein ..	0·63	0·43	0·35	0·34
2. Starch ..	0·08	0·20	0·04	0·02
3. Total sugar ..	0·43	3·00	3·50	3·25
4. Reducing sugar	0·36	2·10	2·40	1·50
5. Titrable acid as citric acid	0·09	0·32	0·26	0·26
6. Alcohol insoluble residue	26·60	20·00	15·00	11·60

NOTE: Substrates calculated on the basis of % of fresh weight.

Table II shows the variations in the substrate concentration in the fruit under different conditions of storage.

The results show that the effect of ethylene is more marked on the fruits gathered at the maturing stage, in conformity with the

TABLE II

Fruits under storage

(Original Substrate Concentration: 100)

Substrates	Concentration at the end of a period of 7 days			
	Early Stage	Enlarging Stage	Maturity Stage	Senescence Stage
1. Protein ..	R—39·25	73·00	72·92	52·47
	C—42·85	83·74	84·51	60·23
	E—21·43	62·53	51·26	48·76
2. Starch ..	R—14·80	43·81	32·67	23·42
	C—19·02	51·39	41·49	28·73
	E—10·75	40·45	16·30	8·24
3. Total sugar	R—53·37	66·67	172·47	163·46
	C—62·36	88·00	180·74	165·52
	E—31·41	73·30	439·17	336·00
4. Reducing sugar	R—39·30	76·17	149·32	130·13
	C—52·78	92·09	151·48	129·75
	E—38·85	76·17	330·20	234·30
5. Titrable acid as citric acid	R—78·12	82·30	82·00	81·12
	C—86·60	91·40	86·00	82·45
	E—49·74	80·00	65·12	66·41
6. Alcohol insoluble residue	R—24·00	18·88	12·20	11·00
	C—28·00	18·40	20·48	12·00
	E—23·30	16·88	13·60	9·40

R—Stored in a room, temperature : 28° C.–32° C.
C—Cold storage do. 8° C.–12° C.
E—In an atmosphere containing 0·1% ethylene, temperature 28° C.–32° C.

previous report. Further investigations are in progress and the results will be published elsewhere.

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May, 16, 1940.

[1] Kar, B. K.. and Banerji, H. K., *Nature*, 1939, **144**, 597.

A Note on the Embryo-sac of *Acalypha indica* L.

THE Euphorbiaceæ are well known for the abnormalities of embryo-sac development, presented by several genera. As many as four distinct types have been reported in this family:—(*a*) *Normal-type*, (*b*) *Allium-type*, (*c*) *Peperomia-type*, and (*d*) *Fritillaria-type*. Even the single genus *Euphorbia* shows all these variations (for detailed information see Maheshwari,[1] 1937).

The material of *Acalypha indica*, which was collected at Agra, showed almost all the important stages in the development of the ovule and embryo-sac. There are two integuments of which the inner remains small and the outer grows out to form the micropyle. Both remain free from each other and the inner from the nucellus, throughout the development of the embryo-sac. The obturator begins growth soon after the integuments have been laid down and finally fits over the beaked nucellus like a bell.

Usually there is a single archesporial cell (sometimes 2 or 3 may be found) which divides into the primary wall cell and the megaspore mother cell. The former divides both periclinally and anticlinally to give rise to the nucellar beak, in whose formation the epidermal cells also take some part. The latter (MEG. M. C.) enlarges and undergoes the two reduction divisions but no walls are laid down in this process, and each of the tetrad nuclei divides again so that four groups are formed consisting of two nuclei each. One more division takes place, resulting in 16 nuclei, arranged in four quarters. So far these observations correspond closely to those of Tateishi[2] (1927) on *Acalypha australis*. The organisation of the mature embryo-sac presents a great variation, however. In most cases the cytoplasm aggregates around 2 nuclei of each quartet and they become separated towards the periphery by the formation of a limiting membrane. Two nuclei of each quartet, which have remained free, migrate to the centre so that the secondary nucleus formed by their fusion is octoploid.

In a few cases the organisation of the E.S. was like that of the Penæaceæ with 4 groups of 3 cells each and only 4 free nuclei left in the centre (*cf.* Stephens,[3] 1909). Occasionally there was lack of any definiteness in organisation and some peculiar arrangements were seen, which

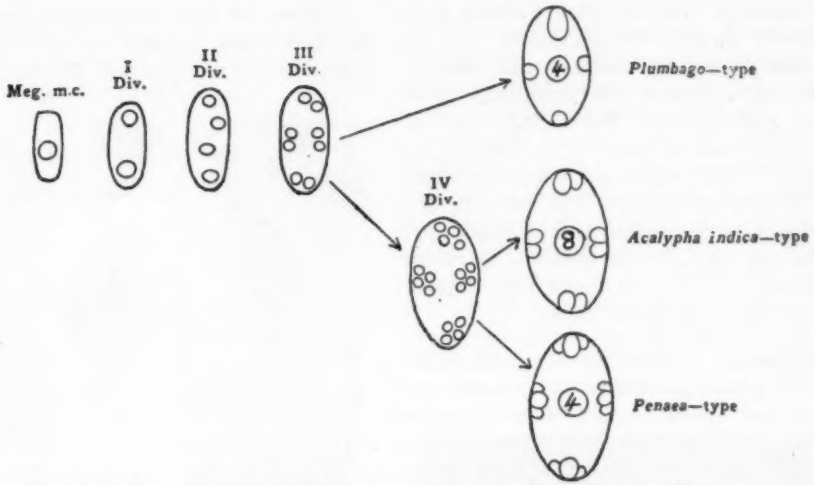

Diagram showing relation between embryo-sacs of *Plumbago*, *Acalypha indica* and *Penæa*

will be described in detail in the full paper. From what has been said above it will be apparent that the embryo-sac of this plant does not agree fully with any that has been described so far. It seems to be most closely related to the *Penæa*-type on the one hand and the *Plumbago*-type on the other (Haupt,[4] Dahlgren[5]). The diagram given above will serve to bring out the relationships more clearly.

Another paper, which is under preparation by one of us (P.M.) will show that all of these types are to be derived finally from the monosporic 8-nucleate embryo-sac which is met with in the majority of Angiosperms (see also Maheshwari,[6] 1939).

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Dacca,
May 18, 1940.

[1] Maheshwari, P., *New Phytol.*, 1937, **36**, 359.
[2] Tateishi, S., *Bot. Mag. Tokyo*, 1927, **51**, 477.
[3] Stephens, E., *Ann. Bot.*, 1909, **23**, 363.
[4] Haupt, A. W., *Bot. Gaz.*, 1934, **95**, 649.
[5] Dahlgren, K. V. O., *Bot. Not.*, 1937, 487.
[6] Maheshwari, P., *Chron. Bot.*, 1939, **5**, 417.

A Note on "Double Fertilisation" in *Ephedra foliata*

THOUGH the cases, in which "double fertilisation" (*i.e.*, fertilisation of the ventral canal nucleus as well as the egg by the two male nuclei discharged from the pollen tube) has actually been observed in the Gymnosperms, are few, yet considering the fact that the ventral canal nucleus is sister to the egg and therefore homologous with it, the theoretical possibility of its behaving like the former and being fertilised cannot be denied. As early as 1899, Chamberlain[1] called attention to a case in *Pinus laricio* where the ventral canal nucleus becomes as large as that of the egg, passing through a similar developmental history. In *Thuja* (Land,[2] 1902), the same ovule occasionally showed some embryos directed upwards into the nucellus and others going downwards into the gametophyte, and it was concluded that most probably the former were formed as a result of the activity of the ventral canal nucleus which had also been fertilised side by side with the egg. In *Ephedra trifurca* Land[3] (1907) saw a prominent nutritive tissue in the micropylar region of the egg cell, and Berridge and Sanday[4] (1907) made a similar observation

in *E. distachya*. Porsch[5] (1907), after a study of Land's figures and statements on the formation of the so-called nutritive tissue in *E. trifurca*, suggested the probability of its having originated from the ventral canal nucleus which was fertilised by the second male nucleus. In *Abies balsamea* (Hutchinson,[6] 1915) and *Ephedra campylopoda* (Herzfeld,[7] 1922) a fertilisation of the ventral canal nucleus as well as the egg was actually observed in several undoubted cases, thus confirming the interpretation of Land's figures by Porsch.

Maheshwari[8] (1935) figured an egg cell of *Ephedra foliata* in which the ventral canal nucleus had already begun to degenerate while the female nucleus was still unfertilised. A study of post-fertilisation stages in *E. foliata*, made by me, also confirms that usually the ventral canal nucleus has no further part to play. Nevertheless, two or three preparations were encountered which show a possibility of an occasional fertilisation of the ventral canal nucleus by the second male gamete. This is suggested by Fig. 1, which shows one male nucleus in proximity to the egg and another close beside the ventral canal nucleus (see also Fig. 2 *a* and *b*). In another fertilised egg cell (Fig. 3) four nuclei were seen of which the two basal ones are undoubtedly the primary proembryonal nuclei resulting from the egg nucleus. The other two, situated in the micropylar part, are much smaller and without the surrounding cytoplasmic sheaths characteristic of the former. Three interpretations are possible with regard to them, *viz.*:—

(*a*) That they are also proembryonal nuclei which have for some reason failed to keep pace with the other two and are on the way to degeneration.

(*b*) That they are nuclei of the jacket cells, which have "wandered" into the egg cytoplasm.

(*c*) That they are the two nuclei resulting from the division of the ventral canal nucleus after it is fertilised by the second male nucleus.

Of these the first interpretation seems to be the least likely, because no other case of a similar nature was observed although I had at

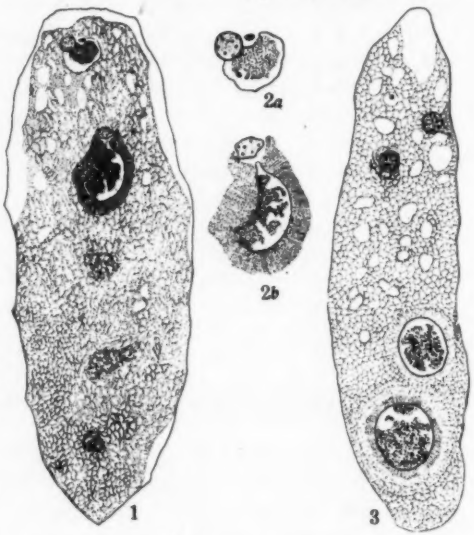

FIG. 1.—L. S. egg, showing 'double fertilisation'. × 210.

FIG. 2, *a*. *b*.—A part of the same enlarged to show the male nuclei in contact with the ventral canal nucleus and egg respectively. × 320.

FIG. 3.—L. S. egg, showing 2 primary proembryonal nuclei at the basal end and 2 nuclei derived from the fertilized ventral canal nucleus at the upper. × 210.

my disposal several slides showing proembryonal stages. The nuclei of the jacket cells do enter the egg occasionally, but in this preparation there was no evidence of this kind. The only plausible explanation seems to be the last one. A more or less similar stage was once noted by Nichols[9] (1910) in *Juniperus*.

It seems that in those cases where both the male nuclei from a pollen tube are functional and the ventral nucleus is not too ephemeral, such cases of "double fertilisation" may be of frequent occurrence. I am, however, not inclined to attribute any phylogenetic significance to this phenomenon. It seems to be the natural outcome of a tendency towards fusion between any two nuclei of opposite sexual

potencies. The condition is *not* comparable with that in Angiosperms, where we have two polar nuclei resulting in 'triple' fusion.

Further details will be given in a fuller paper which will be published elsewhere.

In conclusion, I take pleasure in acknowledging my indebtedness to Dr. P. Maheshwari for help and guidance and for his kindness in making over to me his slides of *Ephedra foliata* on which this study has been based.

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May 19, 1940.

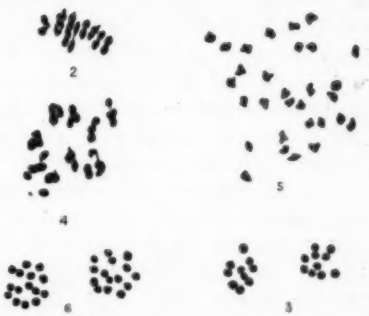
[1] Chamberlain, C. J., *Bot. Gaz.*, 1899, **27**, 268.
[2] Land, W. J. G., *Ibid.*, 1902, **34**, 249.
[3] —, *Ibid.*, 1907, **44**, 273.
[4] Berridge, E. M., and Sanday, E., *New Phytol.*, 1907, **6**, 127, 167.
[5] Porsch, O., *Versuch einer Phylogenetischen Erklärung des Embryosackes und der doppelten Befruchtung der Angiosprmen*, Jena, 1907.
[6] Hutchinson, A. H., *Bot. Gaz.*, 1915, **60**, 457.
[7] Herzfeld, S., *Denkschr. Akad. Wissen. Wien Math-Natur Kl.*, 1922, **98**, 243.
[8] Maheshwari, P., *Proc. Ind. Acad. Sci.*, (B), 1935, **1**, 586.
[9] Nichols, G. E., *Bot.* Centralbl., 1910, **25**, 201.

Autotriploidy in *Toria* (*Brassica campestris* L.)

THE only instance of autotriploidy in the genus Brassica is that reported by Morinaga and Kuriyama[1] in rape (*B. napella*) which has $n = 19$ chromosomes. At the Botanical Section of the Imperial Agricultural Research Institute, New Delhi, where a large number of cultures of the cultivated Brassicæ are being studied, two triploid plants were discovered in two different cultures of *toria* (*B. campestris*). The triploid plants were bigger than the diploids and had rather thick leaves and stems. The flowers were also bigger than the normal with broader petals, stouter anthers and styles (Fig. 1). The anthers dehisced easily and the pollen grains were of varying sizes; the pollen sterility was about 40 per cent. The plants did not set seed when selfed—this species being self-sterile—but yielded a good amount of seed under conditions of open pollination.

The pollen meioses of the triploids and diploids were studied by acetocarmine smears. The diploid showed ten bivalents at diakinesis and metaphase I (Fig. 2) and two groups of ten univalents each at metaphase II (Fig. 3). The two divisions in the diploid were carried out regularly and the pollen grains formed were of uniform size and stained well with acetocarmine. In the majority of P.M.C.s in the triploids, at diakinesis, the chromosomes

1. *(Left)* Diploid; *(Right)* Triploid



were found as trivalents, bivalents and univalents in varying proportions. In a few cases, however, the maximum association of ten trivalents was found in each cell. Fig. 4 illustrates a cell in late diakinesis with $8^{III}+2^{II}+2^{I}$ which is the most common association found

in the triploids. At metaphase I the trivalents and bivalents line up at the equator while the univalents lie outside the spindle nearer to the poles. At anaphase, the trivalent chromosomes disjoin into their components and one travels to one pole and the other two to the opposite pole. Fig. 5 illustrates an anaphase in one of the triploids. The univalents are generally included in the daughter nuclei without division, although occasionally in some cells, they are seen to divide late on the spindle. At anaphase II, the most common distribution of the chromosomes is 16 and 14, although 15 and 15 is found in several cells (Fig. 6). The second division is less irregular and pollen grains are formed as triads, tetrads and pentads. The seeds set on these plants by open pollination will be sown next season for study of the chromosome distribution in the viable progeny.

The exact mode of origin of spontaneously occurring triploids is not usually known but is believed to be due to the union of a haploid gamete with a diploid gamete or the fertilization of the haploid egg by two male nuclei. In the genus Brassica where frequently purely maternal offspring result from interspecific crosses Noguchi[2] has shown that the egg develops by diploid parthenogenesis following the stimulation by the male nucleus which ultimately disintegrates. U[3] who obtained triploid hybrids in interspecific crosses with Brassica, involving the duplication of maternal chromosomes in some and paternal chromosomes in others, considers that in the former case the egg cell which was stimulated to an apomictic development by the presence of the male nucleus, fused with the latter after doubling its chromosomes. He also thinks that the extra paternal chromosome set in some of his hybrids must have resulted from the fertilization of the haploid egg by two male nuclei. Our experience with interspecific crosses in Brassica has clearly shown that pseudogamy is of frequent occurrence. In several of our interspecific crosses, purely maternal offspring has been obtained from crossed seeds. In one instance 64 seeds obtained by crossing *toria* (*B. campestris*, $n = 10$) with *rai* (*B. juncea*, $n = 18$) gave rise to 15 plants of which 14 were like the mother and one was a triploid hybrid with 38 chromosomes made up of two sets of maternal and one set of paternal chromosomes. This case, obviously is similar to those reported by U, and the origin of the triploid may be due to the fusion of the male nucleus with the egg after doubling of its chromosomes. This appears possible considering the wide prevalence of pseudogamy in the genus and the absence of the formation of unreduced gametes in the parent species. In this connection, it would be of interest to know if autotriploids in pure species could also arise by this means, apart from dispermy, where no foreign element is present to stimulate the apomictic development of the egg. We have been able to get a few seeds from *toria* plants by emasculating the flowers in the bud stage and bagging them without pollination and all the seeds so obtained gave rise to plants exactly like the mother. It therefore seems possible that stimulation by a foreign nucleus is not always necessary for the apomictic development of the egg in at least some cases in the Brassicæ and that autotriploids may arise in a similar way as hybrid triploids. This subject is under detailed study.

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New Delhi,
April 30, 1940.

[1] Morinaga, T., and Kuriyama, H., *Cytologia*, Fujii, *Jub. Vol.*, 1937, **967**.
[2] Noguchi, Y., *Proc. Imp. Acad.*, 1928, **4**, 617.
[3] U.N., *Jap. J. Bot.*, 1935, **7**, 389.

Perennation in *Oedocladium operculatum* Tiffany

Œdocladium operculatum Tiffany is the commonest species of *Œdocladium* in the Kumaon hills. Originally it was found growing in the form of dark-green velvet-like covering on sandy soil around the temple building of famous Baghnath temple at Bageshwar on

11th September 1939. Later on it was found growing in large masses in the compound of the District Board Dak Bungalow at Kapkot, on the Pindari Glacier route at an altitude of 3,750 feet above sea-level.

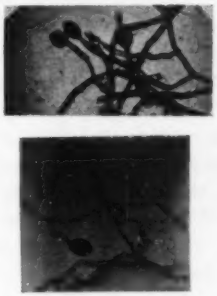
Vegetative cells of the subaerial green portion are 12–14μ broad, 3–8 times as long, each containing a reticulate chloroplast bearing 2–4 pyrenoids. The cells of the subterranean part are brown in colour, are 6μ broad and 5–16 times as long.

This alga is monoecious, oogonia are always single, terminal in position, oval in form, and open by a superior lid. Oogonia are 28–34μ broad and 32–45μ long. Ripe oospores are 24–28μ broad and 32–36μ long, and are yellow or yellowish-brown in colour almost completely filling the oogonium. Spore-wall is scrobiculate with pits 1μ in diameter. Antheridia are hypogynous, usually 2, rarely 3, and are squarish, 8μ × 8μ. The walls of empty antheridia are delicate and are usually found crushed.

RESTING BUDS.—The interest of this form however lies in its peculiar underground resting buds. Perennation in this form takes place not only by means of oospores which are subaerially produced, but also by means of subterranean resting bodies of three different types.

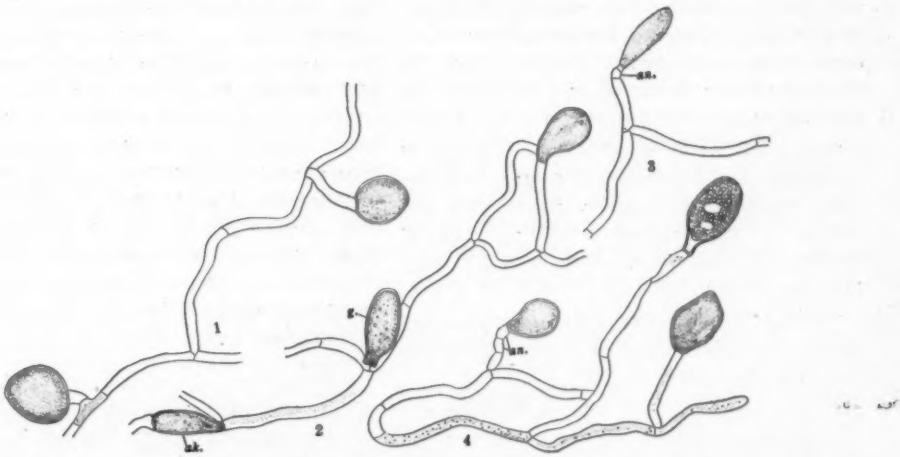
1. *Akinetes.*—These are formed by the storage of starch and other food-materials in some of the shorter cells of the underground filaments. These are recognised by their intercalary position and fusiform appearance (Text-Fig. I: 2).

2. *Gemmæ.*—Very rarely akinete-like thick-walled bodies are found at the nodes of the sub-



Oedocladium operculatum Tiffany.

1. Subaerial part bearing oogonia.
2. Shows rhizoidal part bearing a parthenospore or a modified oogonium. Both about × 80.



TEXT FIG. I.—*Oedocladium operculatum* Tiffany. Various kinds of resting buds, Figs. 1, 3 and 4 show parthenospores or modified oogonia with vestigial antheridia (*an*), 2. Shows an akinete (*ak*) and a gemma (*g*). All × 210.

terranean cells from where branches radiate out in three different directions (Text-Fig. I, 2, *g*). These bodies resemble the underground akinetes described above in form and structure, but differ from them in their nodal position. They resemble the "gemmæ" described by Stahl in *Œdocladium protonema*.

3. *Parthenospores.*—Much more common than the resting buds described above are yellowish-brown bodies which may be described as parthenospores, or arrested and transformed oogonia. They differ from the 'akinetes', and 'gemmæ' in their terminal position. Usually they are pear-shaped in appearance (Text-Fig. I: 1) and rarely club-shaped (Text-Fig. I: 3). They are 40–50μ long and 35–44μ broad, that is, almost of the same size as the oogonia. They are usually full of starch and other food materials, and stain blue-black with iodine. Their morphological nature as arrested and transformed oogonia is evident from their position and size, the presence of vestiges of lids in some cases, and also from the presence of pairs of short cells below them which are reminiscent of antheridia. Chances of fertilisation by the actual escape of sperms under the soil are exceedingly remote, if not well nigh impossible. It is an interesting case of pressing into service subterraneously of an organ which has a sexual function subaerially for the purposes of vegetative propagation and perennation.

In the size of its vegetative cells, shape of its oogonia, and sculpturing of oospore-wall this alga resembles *Œdocladium operculatum* described by Tiffany from Wille's collection of Puertorican algæ, from which it differs only in minor details.

HABIT.—On sandy soil at Bageshwar and Kapkot, district Almora, U.P., India, in September 1939 after rains.

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Aecidial-Stage of the Rust of Linseed

THERE is no record in literature of the occurrence in nature of the æcidal-stage of *Melampsora lini* (pers.) Lév., the rust of linseed, *Linum usitatissimum*, nor has any previous worker reported the germination of its teleutospores, in this country.

During the year 1939–40, the writer carried out germination tests with teleutospores, which were successful, and some inoculations were also made with viable material on seedlings of linseed which produced the æcidial-stage. Inoculations were also made with æcidiospores thus produced, resulting, as expected, in the uredo-stage of the rust under report.

Study of the Uredo-stage: In March 1939, collections of rust on linseed were obtained from Cawnpore, Allahabad and Pusa which contained plenty of uredo and teleuto-material. Uredo-cultures were started simultaneously at the botanical laboratory, Agra College, Agra, and the rust research laboratory at Simla. These cultures were repeated after every three weeks or so. At Agra, no infection could be obtained even in shade after the end of April 1940, whereas at Simla the culture flourished in the green-house as well as in a miniature plot, under natural conditions throughout summer. Even during winter, the rust survived in the miniature plot at Simla. From July to October 1939, all attempts to re-start the culture at Agra with fresh uredo-material obtained from Simla were unsuccessful. Inoculations made in November, 1939, produced good infection and the culture was successfully maintained at Agra in the open till the end of April 1940. These experiments show that the uredo-stage of the rust of linseed cannot stand the heat of summer in the plains.

Germination of teleutospores: As stated above, successful germination of teleutospores of this rust has not been recorded by any previous worker in this country.

A portion of the teleuto-material from collections, referred to above, was kept in a room

in the laboratory at Agra and the rest in a refrigerator. On December 12, 1939, a piece of stem and leaves bearing teleuto-sori, from the Allahabad collection kept in the refrigerator, were soaked in tap water overnight at the room temperature and teleutospores from the same were separated from the tissues with a dancet needle and put on a slide in a moist chamber the following day. The slide was examined every day and on December 18 nearly 60 per cent. germination was noticed and in some cases the sporidia had already been formed. On the next day, sporidia were observed on almost all the germinating teleutospores. All attempts to obtain germination from the material stored in the room at Agra were unsuccessful. Further tests are needed to make sure if teleutospores, kept even in a room in the plains during summer, lose their viability in every case. The tests carried out so far have shown that teleutospores are viable at the time of their formation on the crop in the plains.

Inoculations with germinating teleutospores: Young leaves on seedlings of linseed, raised at Agra, were inoculated with teleutospores that had just started germinating, on January 22, 1940. The plants used in this experiment were raised in a rust-proof seedling house. Spermogonia appeared on January 31, followed by æcidia on February 5, 1940, i.e., 13 days after inoculation. It might be mentioned that no nectar from the spermogonia was mixed in this experiment, nor was it possible for any insect to visit the infected plants as the pot had been kept covered with a double-muslin case throughout. The formation of æcidia without nectar mixing is easy to explain in a case like this because of mass inoculation and the presence of spermogonia very near one another. The range of average maximum and minimum temperatures during the period of the experiment was 63·7°–70·8° and 47°–51° F. respectively, the weekly maximum and minimum temperatures being 77° and 42·5° F.

Inoculations with æcidiospores: Æcidiospores from the æcidia thus formed were put on leaves of seedlings also raised in a rust-proof seedling house on February 22, 1940, and, as expected, the uredo-pustules appeared on February 29.

The above account gives a complete life-history of the parasite under report. As far as the writer can see, the absence of the æcidial-stage in nature in the plains of India is due to the loss of viability of teleutospores due to exposure to very high temperatures after the harvest. Further work should explain the rôle of the teleuto-stage in the hills of India as there is no record of the occurrence of the æcidial-stage from those areas either.

It is not possible to say at this stage whether this rust starts afresh every year in the hills from the æcidia, hitherto unnoticed, or it is also a case of propagation by oversummering uredospores in those areas followed by dissemination to the plains, as recorded by Mehta[1] in the case of wheat rusts.

Several other observations and experiments have been made by the writer on the rust under report and a fuller account will be published elsewhere.

It might be mentioned that the disease under report is one of the commonest crop pests in some districts of the United Provinces and Bihar.

The writer is very grateful to Rai Bahadur Dr. K. C. Mehta for suggesting this piece of work and for the facilities and guidance given during the course of the investigation. Thanks of the writer are also due to Drs. T. S. Sabnis and E. F. Vestal as well as to Mr. R. D. Bose for the supply of material. The writer also wishes to offer his sincere thanks to Mr. H. L. Gulatia for looking after the cultures at the Rust Research Laboratory, Simla.

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May 25, 1940.

[1] Mehta, K. C., *Proc. Ind. Sci. Congress*, 1929, p. 199; *Ind. J. Agric. Sci.*, 1933, 3, 939; *Scientific Monograph* No. 14, *Imp. Council of Agric. Res., India* (in Press).

Stem-end Rot and Soft Rot of Pineapple in the United Provinces

THE cultivation of pineapple has been successful in the Gorakhpur and Pilibhit Districts of the United Provinces, where this crop is being grown for the past few years. Very little information is available about the local important pests and diseases of this crop. A few fruits purchased at the Cawnpore market, which were reported to have been obtained from Gorakhpur District, showed the incidence of stem-end rot. This disease, which has been recorded from the Philippines, Hawai, Fiji, Malaya and South Australia where pineapple growing is an established industry, is known to do considerable damage, specially if the crop is not properly handled after the harvest.

The symptoms of the disease are easy enough to identify by the naked eye. The stem-end region of the fruit shows a water soaked appearance and gradually sinks down; at the same time a yellow fluid exudes if the fruit is pressed. The fruit stalk is also affected; it becomes soft and later on fibrous. The cut end of the stalk devlops a black powdery appearance, and on splitting it open the black colouration can be followed through it right to the heart of the fruit. Even when a very small area at the stem end is affected the stalk is thoroughly decayed and can be easily pulled away from the fruit.

The fungus responsible for this disease is *Ceratostomella paradoxa* (de Seynes) Dade [*Thielaviopsis paradoxa* (de Seynes) V. Höhn]. This fungus has been reported on sugarcane in Bengal by Butler[1] and in Coimbatore by Subramaniam.[2] It is also recorded on *Cocos nucifera, Areca catechu* and *Borassus flabellifer* by Sundararaman.[3] Several other host plants like sugarcane and pineapple were successfully inoculated by Sundararaman by the same fungus. Evidently, therefore, this fungus is widely distributed in India and is common in the sugarcane growing tracts. Gorakhpur District of the U.P. has a large acreage under sugarcane cultivation but so far the fungus has not been recorded in this locality.

This disease of pineapple has not yet been recorded in India.* No control measures can, therefore, be recommended until local conditions have been carefully studied. Work done in other countries indicates that high temperature, dampness and lack of ventilation favour the progress of the disease. The fungus enters the fruit most frequently through the cut end or other exposed surfaces. It is also capable of penetrating even the uninjured surface if suitable conditions are present. Dickson and others[4] revealed that 75·5 per cent. infection originated at the cut surface of the stem and 22·3 per cent. presumably through side wounds, and that it seldom, if ever, took place except through wounds and bruises.

The control measures in other countries have been mainly directed towards preventing infection at the cut stem end of the fruit. In Hawai[5] the harvested crop is left exposed to the sun for an hour or two to destroy the spores of the soft rot fungus and Higgins recommends the marketing of only such fruits as have the stem shrivelled by drying. Treating the cut end of the stem with antiseptics or cauterisation with hot iron has also proved very effective. Judicious crop rotation and avoidance of intercropping with sugarcane has also proved beneficial.

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June 7, 1940.

* Since this was sent for publication it has come to the notice of the author that this disease has been recorded in India by the Imperial Mycologist in the Scientific Reports of the Imperial Agricultural Research Institute, New Delhi, for the year ending 30th June 1939. (Published by the Government of India Press, New Delhi, 1940.)

[1] Butler, E. J., *Mem. Dept. Agric. India, Bot. Ser.*, 1906, **1**, 1.

[2] Subramaniam, L. S., *Imp. Council Agric. Res. India, Misc. Bull.*, 1936, No. 10.

[3] Sundararaman, S., *Agric. Res. Inst. Pusa, Bull.*, 1928, 169.

[4] Dickson, B. T., Angell, H. R., and Simmonds, J. H., *Rev. App. Mycol.*, 1932, **11**, 192.

[5] Higgins, *Hawai Agri. Exp. Sta. Press. Bull.*, 1912, No. 36.

A Free Larval Stage in the Life-history of a Fluviatile Gasteropod

ANIMALS living in inland waters, it is well known, are generally characterised by direct development, free larval stages being exceptional and confined only to a few groups. Among the Molluscs, the bivalve *Dreissensia*[1] is the only freshwater form which is known so far to have a free larval stage in its development. *Dreissensia*, however, is a recent immigrant into inland waters,[1] the immigration having taken place in the eighteenth century, when it appeared in the rivers Volga and the Danube.[2]

Recently, in the course of my studies on the Melaniidæ, a purely freshwater family of Gasteropods, I found that there is a free-swimming veliger phase in the life-history of *Melania* (*Radina*) *crenulata* (Desh.). One variety of this species, var. *tirouri*, inhabits the Coleroon River (Madras Pcy.), about eight miles from its mouth. Preston[3] records the occurrence of this variety in the South Pennar (near Cuddalore), Vizagapatam, Andamans, Celebes, and Philippines.

The majority of Melaniidæ are viviparous, and the young are retained in the brood pouch. Moore[4] recorded the occurrence of a brood pouch in the Tanganyika Melaniidæ, *Tiphobia*, *Tanganyicia*, *Nassopsis*, etc. Among the Indian Melaniidæ, I have observed a brood pouch in the different species of *Melania*, *Melanoides* and *Acrostoma*.[5] Speaking generally, and with special reference to the Indian species, the ova are fertilised in the receptaculum seminis, whence they pass into the brood pouch wherein they undergo their complete development. The young are retained in the brood pouch for a considerable time, and at the time of liberation are found to possess well-formed shells, and resemble the adults in all respects excepting size.

During the breeding season the brood pouch is usually found to be fully packed with developing eggs, and young ones with sculptured shells, the latter being more conspicuous. In the case of *Melania crenulata* the breeding season commences about the month of November and extends till the following April. During this period the brood pouch contains *thousands* of developing eggs, and a few veligers just escaped from the vitelline membrane but no juvenile forms. The enormous number of eggs is a remarkable feature, for, in other species like *Melanoides tuberculatus* or *Melanoides scabra*, only a few embryos and young ones, about two hundred at the most, are found in the brood pouch. Further, the histological structure of the brood pouch of *Melania crenulata* is different from that in the other species, for in the latter the epithelium is modified in relation to the nutritional needs of the post-embryonic and juvenile stages. These features, the enormous number of eggs, the absence of juvenile stages in the brood pouch and modification of the brood pouch epithelium, led me to suspect the presence of a free-swimming larval stage in the life-history of *Melania crenulata*.

Accordingly, intensive observations were made in the laboratory and in the field, and I was able to discover a veliger phase of about two weeks' duration, which is spent in active swimming in the river water. In the first instance, about half-a-dozen veligers were found swimming in the water in the aquarium. Subsequently, examination of water from the river revealed the occurrence of a few free-swimming veligers. For observing the complete development, an attempt was made to rear in the laboratory the larvæ that were obtained by cutting open the brood pouch, and liberating those that had escaped out of the egg membrane, but this was only partly successful. I have been quite successful, however, in rearing in the laboratory veligers collected from the river, by using a mixture of sea water and water from the river.

The full grown veliger of *Melania* has the typical form met with in the life-history of marine Gasteropods, and has two velar lobes provided with long cilia by means of which it swims about rapidly. As stated already, the veliger phase lasts for about two weeks. About

the sixth day of free life the rotatory action of the crystalline style begins, and is very clearly discernible.

Yet another interesting feature was observed. My collections of the veligers were made during March–April, and I noticed during this period a remarkable abundance of the larvæ in the river at high tide (the influence of the tides is felt to a little extent in the river at the place where this *Melania* occurs) on the day previous to the full moon as well as on the full moon day and on the following day. Similarly about the time of the new moon the larvæ were abundant, though not to the same degree. As the breeding season was over by the middle of April, I have to wait till the next season for making further observations on this aspect.

The Melaniidæ are considered to have been probably derived from the Cerithiidæ,[6] and are not known until the Cretaceous period. I do not know of any evidence to show that *Melania crenulata* is so recent an immigrant into fresh waters like *Dreissensia*. In its anatomy *Melania crenulata* resembles very closely other Melaniids such as *Melania tuberculatus, Melanoides scabra*, etc. Yonge,[7] speaking with reference to the Tanganyika Melaniidæ suggested that viviparity and brood pouch might be adaptations for penetration into deep water by freshwater Prosobranchs. I do not consider this view to be tenable, for, as Yonge himself noted, a brood pouch is not confined to the forms living in deep waters, and many of the Melaniids in which I studied the brood pouch are inhabitants of very shallow water. In my view the brood pouch seems to be associated with the migration into inland waters. It may be considered as reminiscent of the saline medium of the ancestors of the Melaniidæ (even as the amniotic cavity is associated with the acclimatization of the aquatic vertebrates to land, and is reminiscent of the ancestral aquatic medium). Immigration inland is generally attended with the suppression of the free larval stages. In most of the freshwater Gasteropods the eggs are provided with albumin and usually with a protective jelly also, and the larval stages are passed through in the egg. In the case of most of the Melaniidæ, the brood pouch affords a suitable environment for the later stages of development as the albumin in the eggs of other genera, and as sea water does for the larvae of the marine species. *Melania crenulata* and a few closely related species, as I will show in a later account, probably never ventured far inland, but have remained near the mouths of rivers, and being subject to a certain extent to the influence of tides and a low degree of salinity still liberate veligers into the partly saline medium. But in most other Melaniids, associated with a greater degree of penetration into inland waters and acclimatization to freshwater, we notice a complete retention of the veligers in the brood pouch, wherein they swim freely, and are nourished by the secretion of the brood pouch epithelium. In *Paludomus*[8] we have an instance of a Melaniid in which acclimatization to freshwater may be considered to be perfect, and which has no brood pouch, the eggs being laid in water.[9]

Further investigations are in progress, and I hope to discuss at length, in due course, this and other interesting features of the family Melaniidæ.

R. V. Seshaiya.

Annamalai University,
Annamalainagar,
May 26, 1940.

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[1] Carpenter, *Life in Inland Waters*, 1928, pp. 11 and 78.

[2] Pelseneer, *Mollusca* in *Treatise on Zoology* (edited by Lankester), 1906, p. 264.

[3] Preston, *Fauna of British India, Mollusca, Gasteropoda and Pelecypoda*, 1915.

[4] Moore, *Quart. Micro. Sci. Jour.* (n. s.), 1898, **41**, 159.

[5] Seshaiya, *Journ. of the Annamalai University*, 1936, **5**, 177.

[6] Cooke, *Cambridge Natural History, Mollusca*, 1913, pp. 17 and 417.

[7] Yonge, *Nature*, 1938, **142**, 464.

[8] Seshaiya, *Rec. Indian Museum*, 1934, **36**, 209.

[9] Ramanan, *Non-marine Mollusca of Madras*, 1900.

The Origin of the Pisiform

WHILE studying the bones of an immature female langur (*Semnopithecus entellus*) it was observed that the pisiform had two centres of ossification, *viz.*, a diaphysial centre giving rise to the major part of the bone and an epiphysial centre for its distal end. This observation appeared significant (Fig. 1). A dissection of

FIG. 1

Pisiform of immature *Semnopithecus entellus*, (left), ×2. Inferior view showing epiphysis, *e*, at distal end.

the wrist of another immature animal and an X-ray photograph (Fig. 2) of an intact limb confirmed the normal presence of an epiphysis for the pisiform in the langur. In an articulated skeleton (of a male adult animal) which the author had previously made, the result of the union of the two constituent parts was seen. The fact that the pisiform bone has in it the elements of a diaphysis and a distal epiphysis has not been recorded previously in this or in any other animal.

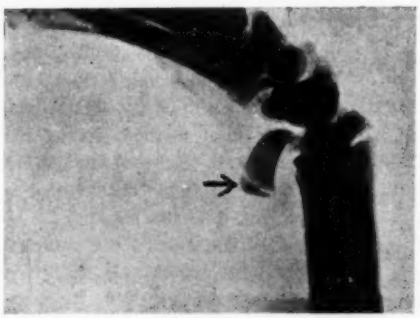

FIG. 2

X-ray photograph of wrist, side view, the arrow pointing to the epiphysis of the pisiform

In the dissected wrist of the langur, the flexor carpi ulnaris muscle was inserted into the epiphysial part of the pisiform whence its prolongations to form the pisohamate and the pisometacarpal ligaments were made out.

The presence of a diaphysis and an epiphysis would lead one to consider the pisiform as a definite skeletal element rather than as a sesamoid bone. According to Keith[1] the M. gastrocnemius in the lower limb corresponds to the M. flexor carpi ulnaris in the upper limb. The insertion of the flexor carpi ulnaris to the epiphysial part of the pisiform is comparable with the insertion of the gastrocnemius to the epiphysial part of the calcaneus. From this it is suggested here, in as much as the primitive carpus and tarsus are similar, that the pisiform appears to be a definite carpal element and that its serial homologue in the tarsus is probably included in the posterior part of the calcaneus.

A fuller discussion on the subject will be published elsewhere.

I wish to thank Dr. P. Kesavaswami, Radiologist, K. G. Hospital, who kindly took the X-ray photograph for me.

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[1] Keith, Sir A., *Human Embryology and Morphology*, London, 1933, 505.

A Lecture Demonstration of Mixed Solvent Action

IT has been observed before that two non-solvents when mixed together may sometimes function as a good solvent for a solute, the case of some forms of nitrocellulose dissolving in a mixture of ether and alcohol forming one of the best examples of this behaviour. Dewaxed shellac is mainly composed of a soft resin, soluble in ether and a hard resin (α-lac) insoluble in it. This α-lac when dry is practically insoluble in acetone, methyl acetate, water and glycol. It has however been observed, that when a mixture of acetone and traces of water, or acetone and glycol, or methyl acetate and water, or methyl acetate and glycol, is

added to dry α-lac, the latter goes quickly into solution. This phenomenon can be utilised as a lecture experiment to illustrate mixed solvent action.

(1) α-lac (hard lac resin) prepared by repeated extraction of the soft resin portion of dewaxed shellac by ether, is dried thoroughly in vacuum at about 42° C. for three hours, after which small quantities (about 0·5 grams) of it are taken in two sets of three test-tubes. To one set is added 5 cc. each of dry acetone, water and aqueous acetone (10 per cent. water) respectively, whilst to the other set is added 5 cc. each of dry methyl acetate, glycol and a 1 : 1 mixture of methyl acetate and glycol respectively. It will be noticed that the α-lac in contact with the mixed solvents goes into solution in a minute or so at ordinary temperature whilst with the single non-solvents, no such dissolution takes place even on warming.

(2) As the preparation of α-lac from shellac involves a somewhat laborious process for ordinary demonstration experiments, dewaxed shellac which is available in the market could be dried under vacuum as before and experiments conducted with it in the same manner. Experiment with methyl acetate-glycol mixture is easier to demonstrate since the shellac need not be very carefully dried and the sensitivity of the experiment to a small quantity of impurities is far less. The solvents must be dried by the ordinary laboratory methods before using.

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Detection of Adulteration in Ghee by a Study of its Fluorescence

The property of ghee (clarified butter-fat), to produce a characteristic fluorescence under the influence of ultra-violet light was utilised independently by Jha[1] and Muthanna and Mukerji[2] to evolve a method for detecting its adulteration. The former reported results of a qualitative study covering a number of samples of ghee and its common adulterants. The latter while confirming the qualitative observations, developed a quantitative method for measuring the intensity of the fluorescence so produced. Using a Pulfrich photometer these authors obtained 'standard curves for the common adulterants of ghee'. In these studies fresh samples of clarified butter fat were used.

As pointed out previously in a note,[3] there are a number of factors that require consideration in any study purporting to deal with the quality of butterfat, and as long as one is in the dark regarding the identity of the particular substance or substances responsible for the reported fluorescence in ghee, all factors which influence its behaviour such as the season, feed, period of lactation, breed and species peculiarities and others need careful attention. Equally important is the question of the age of the sample. The work so far reported on the subject goes to show that under certain given conditions, the age of the sample exerts considerable influence on the known "butter constants". Added to these are the commercial practices in this country of colouring almost the bulk of the marketed ghee and butter with a variety of artificial colours.

Since reports regarding the typical fluorescence of ghee were encouraging, it was considered of interest to study the limitations, if any, imposed on the method suggested by Muthanna and Mukerji (*loc. cit.*) by the factors mentioned in the foregoing. The present communication is confined to the results of a study of the influence of the age of the sample and the artificial colours. Work is in progress concerning the other factors.

A number of ghee and butter samples which were received in the laboratory for examination were subjected to the fluorometric analysis, after their regular analysis was finished. Some of these samples were fresh and genuine and the others were old and were stored in the laboratory for the last sixteen months. One sample was nearly nineteen months old,

Samples of crude groundnut oil and hydrogenated vegetable fat were also similarly analysed in the ultra-violet. "Laktone" butter colour, which is commonly used by the dairy industry for imparting a pleasing tint to butter, was also included in the study. Measurement of the intensity of fluorescence in each case was made in a Pulfrich photometer having an improvised ultra-violet attachment.

A solution of quinine sulphate (880 ρ per litre) served as the standard. Ghee has a greenish fluorescence, its adulterants having blue or shades of blue. It was therefore considered appropriate to sift the resulting fluorescent light through the respective colour filters so that only these components of the ultra-violet light which are considered characteristic of ghee and its adulterants, alone are available for measurement. For this purpose filters 10 and 11 which allow wave-lengths 520–540 Å and 450–490 Å respectively, supplied with the instrument were employed. Light from the standard and the experimental solutions as it emerges from these filters was then matched in the instrument. The experimental solution in each case was made up of one volume of melted fat and three volumes of chloroform. The results are given below.

Serial No.	Substance analysed.	Age of the sample.	Colour of fluorescent light as seen with naked eye.	Strength of blue component (standard at 100).	Strength of green component (standard at 100).	Ratio of blue to green.	Remarks on quality of sample.
1	Butter	15 months	Bluish-white	100·0	61·0	1·65	Genuine
2	Ghee	2 weeks	,, ,, bright	20·0	12·0	1·66	75 per cent. f.f.
3	Butter	2 ,,	Yellowish green	36·0	10·0	3·6	Genuine
4	Ghee	18 months	Bluish-white	46·0	22·0	2·1	,,
5	Butter	15 ,,	,, with a tinge of green colour	14·0	5·0	2·8	,,
6	Ghee	8 ,,	Light blue	11·0	4·0	2·75	*Adulterated
7	Ghee	11 ,,	Blue	11·7	7·0	1·7	Genuine
8	Ghee	9 ,,	Bluish-white	9·0	7·0	1·3	*Adulterated
9	Ghee	10 ,,	,,	13·0	9·0	1·4	,,
10	Ghee	11 ,,	,,	25·0	12·5	2·0	Genuine
11	Ghee	9 ,,	,,	16·0	7·5	2·1	20 per cent. f.f.
12	Ground-nut oil (Crude)	13 ,,	Blue	100·0	62·0	1·65	..
13	Hydrogenated vegetable fat	12 ,,	Bright purple-blue	47·0	30·0	1·6	..
14	' Laktone " + Groundnut oil	..	Bluish-white with green tint	150·0	75·0	2·0	..
15	" Laktone "	..	Yellowish	Faint	Nil	..	..

* The adulterant is not more than 15%. f.f. Foreign fat

The above results clearly show that the green or greenish fluorescence which is considered typical of ghee is not so in fact. A combination of the blue fluorescence of crude groundnut

oil and the yellow of the "Laktone" butter colour produces the same greenish tint that is associated with ghee (*cf.* samples 5 and 14). This observation is of considerable importance because it reveals that the green fluorescence is no criterion of the genuineness of the ghee.

To see if any quantitative relationship exists between the intensities of the blue and the green components, the ratios of blue/green were calculated in each case. This value (*cf.* column 7), too, fails to indicate any bearing on factors like age and purity of the sample. It therefore seems that even if steps were taken to remove the artificial colour from the fat prior to the analysis, the method promises no hope.

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[1] J. B. Jha, *J. Ind. Chem. Soc., Ind. and News Edn.*, 1939, **1**, 159.

[2] M. C. Muthanna and B. Mukerji, *Curr. Sci.*, 1940, **9**, 120.

[3] G. Narasimhamurty, *Curr. Sci.*, 1940, **9**, 235.

Review of Recent Investigations at the Punjab Irrigation Research Institute

I HAVE read the review of the Punjab Irrigation Research Institute, Research Publication No. 23, Vol. II, 1939, which appears on pages 202 and 203 of the April issue of *Current Science*. Your reviewer has given an excellent summary of the Punjab investigations and the conclusions that have been reached by Dr. Bose and Dr. Malhotra. I feel, however, and the two authors of the publication agree with me, that your reviewer has not given sufficient credit to Mr. Lacey, whose work led directly to these investigations.

Mr. Lacey's work undoubtedly re-opened the question of silt in its relation to regime conditions and he has made notable contributions to this subject. During the past ten years, the Research Officers of the Central Board of Irrigation have met frequently to discuss the subject. The work which has been carried out in the *Irrigation Research Institute*, Lahore, has arisen out of the discussions between Mr. Lacey and the Research Officers of the Punjab which took place at these meetings.

The notation adopted in the Punjab publication under reference is that of Mr. Lacey except that '*m*', the mean diameter of the silt on the bed, is used instead of '*f*', Mr. Lacey's silt factor. I would like to say that Mr. Lacey's work formed the starting point for the investigations carried out in the Punjab, although the methods of investigation and the apparatus connected with it have been devised by the Research Officers of the *Irrigation Research Institute*, Lahore. I am sure your reviewer will not object to my drawing attention to the valuable work of Mr. Lacey.

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THE NEUTRALISATION VALUE OF GHEE (BUTTER-FAT)

BY
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THE best known test for the genuineness of butter-fat is a determination of the Reichert Value (R.V.). Probably there is no public analyst who does not use this test, at least for sorting purposes; while many do little or no further investigation if the value is normal.

In countries where butter is prepared from the milk of well-kept herds of cattle, the R.V. will detect quite moderate adulteration, the butter from such herds being only subject to small seasonal variations. In India the problem is very different. Ghee is prepared from the milk of animals—usually buffaloes—kept under very varying conditions, both climatic and controllable. There are herds that are well fed in a temperate climate; others live in the tropics and get little food beyond such pasture as they can find on waste land. It is not surprising to find that, with animals maintained so differently, the composition of the butter-fat derived from them does not show the constancy of composition of that from dairy herds; in fact buffalo ghee can yield R.V.'s varying from below 20 to over 40, though most samples come within a more restricted range. The R.V. varies with the proportion of Butyric Acid and it is an unfortunate fact that most of the other tests that are commonly used have a similar dependence, *e.g.*, Kirschner, Saponification, and Ave-Lallemant values. Specific tests for certain adulterants, *e.g.*, Polenske test for coconut oil, are of great value in special cases but in the absence of an identifiable adulterant the analyst is faced with a difficult task when a sample gives a R.V. slightly below normal. The figure is low because there is a deficiency of butyric acid and he has to decide whether this deficiency is due to abnormality, or adulteration with a fat that does not contain butyric acid.

It is very seldom that the saponification value will give useful information for when butyric acid, an acid of low molecular weight, is deficient, the saponification value will automatically fall. The refractive index will sometimes give a hint, but here again butter-fat with a low R.V. tends to have a high refraction. When an adulterant is present it is commonly of vegetable origin and then the sterol acetate will give positive information, but the test takes a lot of time and involves an elaborate technique; further, it will not detect animal fat.

It occurred to the author that the neutralisation value (N.V.) of the fatty acids might be of value. At first sight it might be thought that this figure would parallel the saponification value. This is not so since the latter is determined on the whole fat, including glycerine butyrate, while the neutralisation value depends on the molecular weight of the *insoluble* fatty acids; butyric acid is miscible with water, accordingly it can have no direct effect on the figure. The test has proved to be of considerable value and to give definite evidence of adulteration in a number of doubtful cases.

At the beginning of the investigation it was found that, estimated according to text-book instructions, the value is useless. To prepare the fatty acids the usual instruction is that, after saponification and acidification, the acids shall be "boiled till clear". As butter-fat contains glycerides of fatty acids of low molecular weight such as Caproic and Caprylic which, though but sparingly soluble in water, are freely volatile in steam, the figure obtained will depend on the time of boiling. That the effect is by no means negligible is shown by the following figures obtained on the same sample of ghee:—

Fatty acids cleared by method		N.V.
	described below	214·1
Do.	boiling for 1 hour	212·3
Do.	boiling for 2 hours	211·0

For preparing the fatty acids without undue loss of volatile acids the following technique has been worked out:

About 10 grams of the clear fat is saponified with 30 mils. glycerol-soda (84 grams NaOH dissolved in water and made up to 210 mils.,

and glycerine added to make 1 litre) in a 500 c.c. flask. The product is dissolved in 150 mils. hot water and the flask is placed on a boiling water-bath and fitted with a short air-condenser (about 8 inches of narrow tubing) which is covered with a small inverted test-tube. The flask is then placed on a boiling water-bath and, when it has reached a steady temperature, it is acidified with 10 mils. sulphuric acid of a strength (approx. 17% by volume) such that 9–9·5 mils. will neutralise the glycerol soda. *N.B.*—The strength of the acid must be checked by a blank titration using methyl red as indicator; no indicator should be added to the soap solution. The flask is kept on the water-bath for 3 hours (± 10 minutes) with occasional shaking by rotation to assist clarification. At the end of this time it will be found that the fatty acids are clear. About 50 mils.—which includes all or nearly all the fatty acids—is poured off into a 50 mil. separating funnel; the acids are separated and washed three times with 25 mils. of hot water; they are then filtered in a steam oven into a small beaker. 4·9–5·0 grams of the filtered acids are now transferred with a suitable warm pipette to a weighed 250 mils. extraction flask; weighed to an accuracy of 2 m.g.; dissolved by warming in 50 mils. neutral (to thymol-blue) 90% alcohol and titrated with freshly prepared NaOH of approximately N/2 strength using 1 mil. 0·04% thymol-blue as indicator. The N.V. is then calculated as milligrams of KOH required to neutralise 1 gram of the fatty acid. When a number of determinations are being made it has been found convenient to put the flasks containing the soap solutions on a large water-bath and when—after say one hour—they have attained a uniform temperature, to acidify them at intervals of 5 or 6 minutes—according to the operator's speed of working, —so that the fatty acids can be separated and washed successively after precisely three hours.

Experience has shown that prolonged heating lowers the figure. A sample of ghee gave neutralisation values by the method described of 215·8 and 216·0; two more determinations in which the flask was heated for an additional 10 hours, gave 212·5 and 212·6. The fall in N.V. appears to be due to decomposition of oleic acid. A specimen (several years old) of Merck's Oleic Acid was heated with water (slightly acidified) for 1 hour and 10 hours, washed as usual and the N.V. determined.

After 1 hour the N.V. was 189·3.
„ 10 hours „ „ 182·1.

Unless the flask is rotated occasionally it will sometimes be found that the fatty acids are not clear after three hours. This shaking does not have any effect on the N.V. The N.V. of a sample of ghee was determined in the usual way; it was then repeated, the flask being shaken frequently and vigorously during the three hours' heating. The value was unaltered.

Duplicates should not differ by more than 0·2, but, to get figures as reliable as this, the titration must be carried out with great care and the NaOH solution carefully standardised. In this laboratory the burette is read with a telescopic burette-reader supplied by Messrs. Arthur Thomas & Co., Philadelphia. It has great depth of focus, so that the graduations at the front and back of the burette can be clearly seen at the same time, thus avoiding parallax; readings by estimation are possible to 0·01 mil. and titrations are recorded to this accuracy. For each set of determinations the N/2 NaOH is checked against pure Potassium Hydrogen Tartarate (about 3·45 grams) or Potassium Hydrogen Phthalate (about 3·75 grams); thus all burette readings come between 40 and 45 mils. and minor burette errors are eliminated. As the neutral point is approached the yellow colour of the indicator becomes greenish. There is a point at which all yellow has disappeared but the solution cannot be said to be a pure blue; possibly slate-green best describes it. This point, which is taken as the neutral point, can be judged with great precision; 0·01 mil. N/2 alkali or acid gives an unmistakable change.

The following table summarises the neutralisation values determined on samples of butter-fat prepared in the laboratory from milk samples taken in the Madras Province, and submitted for analysis as buffaloe milk under

Neutralisation value	Number of samples	Reichert Value		
		Mean	Maximum	Minimum
207·0	1	18·9		
207·6	1	23·3		
208·6	1	20·4		
208·9	1	20·9		
209·0	1	20·4		
209·3	1	21·1		
209·4—209·9	7	24·1	25·9	22·4
210 0—210·9	13	24·2	32·0	18·6
211·0—211·9	17	25·8	29·0	23·5
212·0—212·9	15	24·8	28·9	22·3
213 0—213·9	5	26·2	29·7	24·1
214·0—214·9	6	27·5	30·1	23·8
215·0—215·9	4	27·2	30·3	21·3
216 0—216·9	3	28·1	31·8	26·2
217·0—217·9	..	..		
218 0—218·9	1	23·5		
219·0—219·9	1	27·3		
Total ..	78			

the Prevention of Adulteration Act. Samples were usually between 15–20 grams. *N.B.*—The average Reichert Value for Madras butter-fat is higher than the table suggests since for the greater part of the investigation the neutralisation value was only determined on fats giving R.V.'s of below 25; later a number of samples with higher values were included.

The 6 samples that gave figures below 209·4 are given separately, the others have been grouped. It will be seen that though there is some tendency for high N.V. figures to be associated with high R.V., the figures do not parallel each other as do the Saponification Value and R.V. A sample with R.V. 32·0 had N.V. 210·2 while for another sample with R.V. 21·3 the N.V. was 215·0. Two samples of buffalo carcass fat gave N.V.'s 202·6 and 202·9. Two samples of vegetable product 194·8 and 196·7.

As with the R.V. there are a few abnormal figures but it is necessary to take into consideration that these figures were obtained on fat derived from only small quantities of milk and that in the bulked ghee as sold on the market such ghee would be mixed with ghee giving higher figures. In the author's opinion the figures suggest that a sample of bulked ghee giving a figure below 209 is almost certainly adulterated and that any figure below 210 is highly suspicious.

The value of the test is shown by the following table which gives particulars of a number of samples submitted for analysis under the

Sample	R.V.	Butyro Refracto-meter reading at 40°C.	Melting point of Sterol Acetate (recrystallised twice)	N.V.	Opinion
A	21·0	44·7	121·6	209·6	Adulterated with vegetable fat
B	21·7	43·0	115·0	215·9	Genuine
C	22·1	44·1	114·8	208·6	Adulterated with animal fat
D	22·2	43·7	115·0	215·8	Genuine
E	22·6	43·5	115·0	207·1	Adulterated with animal fat
F	23·0	43·4	115·0	210·5	Genuine
G	23·2	43·8	115·0	209·0	Doubtful, probably adulterated with animal fat
H	23·9	43·7	115·0	210·9	Genuine
I	23·9	44·1	117·4	210·4	Adulterated with vegetable fat
J	24·1	44·8	123·0	206·9	do
K	24·3	44·8	120·8	208·4	do
L	25·3	41·5	115·0	222·8	Genuine
M	25·6	43·1	115·0	212·7	do
N	25·9	44·5	115·0	212·4	do
O	25·9	44·7	123·4	208·8	Adulterated with vegetable fat
P	27·1	44·9	122·6	208·9	do
Q	27·3	45·3	121·4	206·7	do

Madras Prevention of Adulteration Act on which both sterol acetate M.P. and N.V. determinations were made.

Of the seven samples that gave a positive sterol acetate, 5 could be condemned on the N.V. alone. One gave a figure between 209 and 210 and would be put aside for further investigation. The test did not detect the adulterant in sample I; the sterol acetate M.P. suggests that little was present. Of the remaining 10 samples, none of which contained vegetable fat, two were classed as adulterated and one was given the benefit of the doubt though it was probably adulterated; the others were passed as genuine.

In addition to the advantage that adulteration by animal fat can often be detected, the test has been found of special value at the present time since it often detects adulteration with vegetable fats without resort to a sterol acetate test, thus conserving stocks of digitonin, which is, at the moment, almost unobtainable.

REVIEWS

James Gregory Tercentenary Memorial Volume. Edited by H. W. Turnbull. (Royal Society of Edinburgh. G. Bell & Sons, Ltd., London), 1939. Pp. xi + 524. Price 25*s*.

"It is proper to record that on a July day in 1938, three hundred years after the year from which this story dates, there was gathered in the library at St. Andrews, where Gregory worked so long, a company of their mathematical descendants, distinguished guests from the world of science, from the Cambridge of Newton, the Paris of Cassini, the Germany of Leibniz, the Flanders of Huyghens, and the New World of America, assembled in a Scotland where mathematics is still pursued for its beauty and its truth. Let us, in our respective Universities, hold fast to this tradition of fellowship and of devotion to learning and thus honour the name of James Gregory." This quotation from the Tercentenary Volume finely expresses the spirit that has animated Prof. Turnbull, and his collaborators in their labour of love undertaken to present the genius and mathematical intuition of Gregory in its true and proper perspective. Prof. Turnbull has succeeded in showing conclusively that Gregory discovered Taylor's theorem, that his work is substantially independent of the contemporary work of Newton, and that he is virtually one of the independent founders of the calculus—achievements which entitle Gregory to a very high rank in the heirarchy of mathematicians.

A biographical sketch of Gregory, followed by short accounts of his scientific contemporaries, serves to provide the background against which the detailed description of Gregory's work is to be viewed. This description is prefaced by an impartial estimate of the mathematical discoveries of Gregory. Next follows what is perhaps the most important part of the work, *viz*., the correspondence of Gregory, specially that with Collins. The letters of Collins are published here for the first time, and serve to bring out new facts about Gregory's work in relation to the work of contemporary mathematicians. The correspondence of Gregory alone takes up nearly sixty per cent. of the space of the volume. Also most of his original manuscripts are published here for the first time, and arranged according to subjects. The correspondence and the manuscripts have been carefully examined by the editor, and their mathematical importance elucidated in a series of illuminating notes and running commentaries which are of the greatest help to a proper appreciation of Gregory's work.

The last part of the Volume consists of contributions from distinguished mathematical historians of Europe dealing with the published works of Gregory and other aspects of his scientific life.

Some of the important letters and manuscripts of Gregory might be noticed here. One of the most interesting of these is letter No. 39 (p. 168) in which series expansions are given for $\tan^{-1} x$, $\tan x$, $\sec x$, $\log \sec x$, $\log \tan (\pi/4 + x/2)$, $\sec^{-1} (\sqrt{2}\, ex)$ and $2 \tan^{-1} \tan h\, x/2$. As shown by Turnbull (see also p. 356) this letter shows clearly that Gregory actually used Taylor's theorem for all the functions except the first, and it is perhaps an irony of fate that the series of $\tan^{-1} x$, after which Gregory is best known, was obtained without using Taylor's theorem but perhaps by integrating the power series for $(1 + x^2)^{-1}$! Letters Nos. 29–31 (p. 118–33) which are explained by copious notes of the editor support Gregory's claim to the discovery of the binomial theorem. Letter No. 53 (p. 230) contains what is virtually D' Alembert's convergence test. Manuscript No. 19 (p. 386) gives a method of attack on the solution of the quintic equation which if pursued would have showed the impossibility of the proposed method, but brings out, nevertheless, "the workings of a mind possessing deep insight into polynomial structure". The letters on pages 251–75 show his interest in astronomical problems, and how his work overlapped that of Newton regarding the construction of reflecting telescopes. Manuscript No. 52 (p. 450) in which Gregory raises searching questions on the nature of light twenty years before the publication of the *Principia* reveal a very acute and inquiring mind. More examples could be given from the veritable mine explored by Prof. Turnbull to show that there was no branch of mathematics or natural philosophy of

Gregory's time which he did not enrich with his penetrating researches.

The Gregory Tercentenary Volume is undoubtedly a notable contribution to the history of mathematics. B. S. M.

Portraits of Famous Philosophers who were also Mathematicians with Biographical Accounts. By C. J. Keyser. (The Scripta Mathematica, New York), 1939. 12 Portraits. Price $3.00.

This portfolio consists of twelve portraits *viz.*, those of Pythagoras, Plato, Aristotle, Epicurus, Bacon, Descartes, Pascal, Spinoza, Leibniz, Berkley, Kant, and C. S. Pierce, and is accompanied with interesting biographical sketches of Prof. C. J. Keyser of Columbia University. The portraits are beautifully reproduced from different collections, in some cases being pictures of ancient statues, and in the cases of Pythagoras and Bacon the pictures are merely the artist's impressions. It might, however, be mentioned that the portrait of Descartes is not so striking as that in D. E. Smith's collection of portraits of famous mathematicians.

A good plan to study the portraits is first to read the biographical sketch, then take a long and deep look at the pictures, close the eyes for a moment, and return suddenly to the portraits. One can thus hardly fail to escape the thrilling feeling of having suddenly come face to face with the greatest minds of all time. The sketches by Prof. Keyser are brilliantly done, and up to the standard that one expects from his vigorous pen. He has excelled himself in the short biographical account of Leibniz.

Of recent years there has been a tremendous surge of general interest in science, and accompanying it a wholesome curiosity to know more about the life and personality of the men who made science. Among this band of great men the philosopher-mathematicians have played a supreme part in the evolution of scientific, mathematical and philosophic thought. This set of fine portraits, enriched by Prof. Keyser's short sketches, is bound to be of the highest educative value. B. S. M.

Two Dimensional Potential Problems Connected with Rectilinear Boundaries. By B. R. Seth. (Lucknow University Studies No. 13), 1939. Pp. 124.

This small brochure of nearly hundred pages is a connected summary of the subject in question with special emphasis laid on the problems which the author himself has been tackling for a number of years. The mention of rectilinear boundaries at once brings up to mind the classical Schwarz-Christoffel theorem of conformal representation, and the author has fully exploited this method by generalising it in a number of directions. He has besides shown the utility of other methods like that of images and of conjugate functions. A special feature of the author's work is a careful examination of the form of solutions near an angular point, a case which is generally not treated rigorously. A short historical introduction followed by a statement of the problem with the associated general theory carefully presented, and finally a series of interesting applications to special cases all go to make up a valuable contribution to this branch of potential theory. B. S. M.

Introduction to the Theory of Functions of a Real Variable. By S. Verblunsky. (Oxford University Press), 1939. Pp. xi + 169. Price 12*sh.* 6*d.*

This is a compact and well-written text-book, but limited in scope, covering roughly the course in analysis of the honours standard of our universities. Taken along with classical text-books such as Bromwich, de la Vallee Poussin, Casàro, etc., it will be a good text-book for honours courses.

K. S. K.

Photography by Infra-red; Its Principles and Applications. By Walter Clark. (Chapman and Hall, Ltd., London), 1939. Pp. 397. Price 25*sh.*

All scientific workers who use photography as a tool in their research work, will find it profitable to go through this authoritative and very readable book on photography by infra-red by a member of the staff of the Kodak Research Laboratories. Besides discussing the fundamentals of the subject in a clear and simple manner, the book provides in a collected form a large amount of valuable information about methods of practice. Many workers would like to have the book on their shelf for frequent reference.

Although the infra-red part of the spectrum was discovered by Sir William Herschel as early as 1800, it was only in the last decade of the nineteenth century that a

photographic emulsion was prepared which was directly sensitive to the extreme red and near infra-red. Since then, and particularly after the last Great War, great progress has been made in the study of sensitising dyes of the multi-carbocynine class, and plates sensitive up to 13,500 A are now commercially available. Two reasons prevent a further practical extension of this limit, one being the presence of "dark space radiation" in sufficient quantity to affect the silver halide grain and the second being the intense absorption exercised by even minute quantities of water vapour. The importance of the first is convincingly shown by some striking photographs taken in total darkness using the heat radiation from an electric hot iron or an under-run electric heater and reproduced in the book. In the region of still longer waves, other methods, mainly indirect, have to be employed. Mr. Clark gives a summary of these other methods, including the volatilisation method of Czerny and his co-workers and the electron-image tube method of Zworykin and Morton.

The application of the method of photography by infra-red for various special purposes is described, for example, the photography of distant landscape through haze or fog, aerial photography for surveying, the examination of pictures and documents, the photography of subcutaneous veins or other structures for medical purposes, photomicrography, etc. In most of these applications, the superiority of the infra-red over visible radiation depends essentially on the much smaller scattering and greater penetration of the former in media containing small particles in suspension. The increase in penetration of fog or haze will naturally be most evident in cases where the scattering particles are small in comparison with the wave-length. When the fog or haze appears white in colour, no appreciable increase in penetration can be expected.

The book contains two very useful chapters on sources of infra-red radiation and on optical characteristics of materials and is provided with full name and author indexes.

K. R. R.

Osmotic Regulation in Aquatic Animals. By August Krogh. (The University Press, Cambridge, 1939. Pp. ii + 242. Price 15*sh.*

In sea and fresh water, there exist a vast and bewildering variety of fauna. These animals are normally permeable to water which constitutes their environment. In spite of this circumstance, it is well known that the concentration of their body fluids differs from that of the surrounding water. The cells, while they maintain an osmotic equilibrium with the medium in which they are bathed, exhibit significant differences with regard to the concentration of single ions. What is the mechanism through which these differences are brought about? Prof. Krogh, in this volume, has presented experimental data to clarify this problem. For a large number of organisms, it has been found that the regulation of ionic concentration is accomplished essentially by an active transport of definite ions through certain cells into and out of the body fluids. In a number of cases, the presence of special mechanisms has been demonstrated by which ions, certain organic substances and sometimes even water, are transported in one direction only and may be moved against gradients and potentials. Here is a specialised kind of "permeability", an illuminating discussion of which is to be found in the section devoted to comments, conclusions and suggestions. This is followed by suggestions for future work on active ion transport, which sets out the most outstanding problems in the field awaiting solution.

Professor Krogh, who is one of the foremost authorities in this field, has incorporated a substantial portion of the experimental work, carried out by himself and his collaborators. Notes on the methods employed in the investigation of these problems, mostly developed in his laboratory, have been appended to the volume. Those interested will find these methods useful and worthy of application in similar studies.

M. S.

Simple Geological Structures. A series of Notes and Map Exercises. Second edition. By J. I. Platt and J. Challinor. (Thomas Murby & Co., London), 1940. Pp. 56 + 4. Price 2*sh.* 9*d.* net.

This is the second and slightly enlarged edition of the well-known book by Platt and Challinor, embodying a series of notes and map exercises on simple geological structures. Starting from the simplest cases of horizontal or uniformly dipping strata, the map exercises are so selected and graded as to take the student gradually through more and more complicated types of geological structure involving faulting, folding,

igneous intrusions, etc. The maps themselves have been very nicely reproduced, and the notes accompanying them are so clearly written that the student can easily follow and understand the interpretation of the underlying geological structure. To be able to 'read' a geological map is a very important part of a geologist's training, and we have no doubt that this little book by Platt and Challinor, used along with the other one by Platt on *Elementary Exercises upon Geological Maps*, will be found highly useful in giving a suitable introduction to the study of geological structures.

L. RAMA RAO

Sulphated Oils and Allied Products: Their chemistry and analysis. By Donald Burton and George F. Robertson. Foreword by Prof. T. P. Hilditch. (A. Harvey), 1939. Pp. 163 + iv. Price $5·00.

Much progress has been made and many gaps filled in our knowledge of the chemistry of the sulphation process and in the production and application of sulphated products. The need for an up-to-date book presenting all the data on this subject, hitherto greatly felt, has been filled by the publication of the volume under review.

The subject-matter has been divided into three parts beginning with a historical survey of the sulphation process and its applications with 84 references to the literature, Chapters 2 and 3 deal respectively with the chemistry of raw materials and methods of sulphation of fatty acids, esters and other derivatives of fatty acids, fatty alcohols and their derivatives, with 26 references, and the chemistry of sulphation, saturated and unsaturated acids with their glycerides, unsaturated hydroxy acids and their glycerides, unsaturated acids with an acetylene linkage, and a summary of the reactions taking place in sulphation with 25 references. The third part of the book deals with the analysis of sulphated oils, the various tests, qualitative and quantitative, with 27 references and of sulphated fatty alcohols with 34 references, and of petroleum sulphonic acids with 8 references.

Prof. T. P. Hilditch contributes an interesting Foreword to a publication which should be of the greatest value to all those connected with the textile and textile chemical industries.

J. P. DE SOUZA.

The Control of Weeds. Edited by R. O. Whyte. (Herbage Publication Series, Bull. 27. Published by the Imperial Bureau of Pastures and Forage Crops, Aberystwyth), 1940. Pp. 168. Price 7*sh.* 6*d.*

The control of weeds whether they be in farms, pastures, rivers or lakes is an international problem of high economic importance. In India, very little work has been done so far in this direction in spite of the fact that the problem, in some parts of the country, is really menacing. The reason why this subject has not so far received attention, is probably due to the circumstance that very often the remedy suggested is too expensive or research suggests the same remedies as are commonly in vogue.

But outside India, very extensive work is being carried out; there are weeds which can be eradicated by cultural, biological or chemical methods. The eradication of the prickly pear by *Cactoblastis cactorum* and of *Lantana camara* in Australia by an insect imported from Fiji are very recent and outstanding examples of biological control. Sometimes, though the remedy found is very expensive, yet the farmers have adopted it willingly for the very simple reason that the farms have been completely immunised within a period of five to six years.

The present bulletin gives a very comprehensive account of the work carried out in the world; it is regrettable that no article is contributed either from Great Britain, South Africa or India. The problem is treated by different writers from different aspects, *viz.*, the study of weeds of the farm, their root-systems and the time and depth of germination of their seeds; the weeds of the turf and their methods of eradication by nitrogenous and phosphoric manures; the application of herbicides like the compounds of arsenic and the cyanides, etc; the poisonous properties of many weeds which when eaten at certain periods (when showers of rain follow periods of drought) cause hydrocyanic acid poisoning or photosensitization in animals with unpigmented skin.

From whatever point of view the problem has been attacked, almost every contributor has shown remedial measures which if followed must result in very great economic gain. But it must be here emphasized that for the total eradication of the evil, an extensive administrative machinery is necessary. Right type of legislation has done much in America and Germany.

This bulletin will serve long as a guide for research and organization in the subject and it is hoped that at least some of the important suggestions made in it will be taken up in India. F. R. B.

Environment and Heredity. By Olive D. Maguinness. (Thomas Nelson & Sons, Ltd.), 1940. Discussion Books No. 36. Price 2*sh.* 6*d.*

This is one of the series of books called the "Discussion Books" which are designed to help intelligent citizens in discussions on modern world topics.

The book is written by a biologist who has devoted her life to teaching biology not as an academic subject but as an applied one and in her present book we see the fruits of her labour of ten years as Lecturer in Education in the University of Sheffield.

In this small book of 200 pages, the old problem which is still perplexing the biologists, is revived in a very refreshing manner. With the rapid development of the Morgan School of Genetics, biologists are too apt to forget that an organism is also a part product of its environment and not only of its genes, just as the rapid development of physiology has led many biologists to believe that life can be explained fully in terms of physico-chemical reactions.

After briefly mentioning the problems of Evolution in the introductory chapter, she discusses Mendelism and its recent developments bringing the account up to date. Then she discusses in the remaining six chapters the application of modern genetical laws to man and society and shows how difficult it is to predict the future progeny, for, each case is governed by a number of internal and external factors which we are yet unable to understand.

The book is an admirable attempt to show impartially how much Environment and Heredity play part in each individual's life. This book should be widely read by the students of biology for here, in a short space, are presented all the modern facts worth knowing. F. R. B.

Biological Notes on Indian Parasitic Chalcidoidea. By H. S. Pruthi and M. S. Mani. (Imperial Council of Agricultural Research, Bulletin No. 30), 1940. Pp. 119. Price Rs. 3.

Entomologists in India are deeply indebted to Pruthi and Mani for publishing the *Biological Notes on Indian Parasitic Chalcidoidea,* which is intended to be only a beginning, and we think it is a very good begining. The publication is copiously illustrated and the drawings are so well executed that the artist also deserves the thanks of the reader. However, Fig. 13 shows the wings covering the major part of the insect's abdomen which, though more natural, is an unusual representation for illustrative purposes. Fig. 40 shows an Elasmus parasite with the abdomen below the coxæ, which themselves are seen sideways as flat disc-like objects, an unhappy contrast to the excellent representation of another species, Fig. 41.

In compiling the references, the authors could have exercised more critical judgment. The *Bulletin* purports to communicate biological notes and as such it was expected that the most important reference to the literature on the particular insect should have been given; if such a selection were not possible then all the references to published articles should be given. To give a concrete example, a few years ago an article was published in *Annals of Am. Ent. Soc.* on *Elasmus claripennis,* not mentioned by the Editors, but which nevertheless is the most informative reference on the biology of this insect. Incidentally it was also mentioned that there still exists another species for which the name *Elasmus Colemani* should be retained. It is nowhere mentioned that there is now in Mysore, the first parasitic laboratory in India, where an insect is called *Trichogramma minutum,* which is uncritically dispensed with the remark that Flanders considers it as only a variety of *T. evanescens. Tachardiæphagus tachardiæ* is considered specifically distinct by the discoverer of *T. somervilli* whereas Pruthi and Mani pass over the details mentioned as to the different hosts from which these two parasites can be obtained as though one was undoubtedly a variety of the other. Further they could have saved themselves the trouble of drawing Fig. 33 for, *T. tachardiæ* has been already illustrated by Imms and Chatterjee as Fig. 31 of their Memoir,—a reference not given in the bibliography.

The name of the host *Ceroplastodes cajani* as on p. 14 is wrongly named *Ceroplastes cajani* on p. 15, whereas in the Index, on p. 37, the generic name Ceroplastes stands also for insects now to be called *Ceroplastodes* sp. S. M.

INTERNATIONAL TRADE IN OILS AND FATS

International Trade in Oils and Fats. Studies of Principal Agricultural Products on the World Market, No. 4: Oils and Fats: Production and International Trade—Part I. Pp. 350, 8vo. Price 25 lire. No. 5: Oils and Fats: Production and International Trade—Part II. Pp. 430, 8vo. Price 25 lire. (International Institute of Agriculture, Rome), 1939.

A WORLD system of economics is an ideal to which even national politicians paid lip-service in 1933. After the present war has further dissipated the world's resources, it will become more than an ideal; it will become a necessity. Although at the present time it is difficult to be optimistic about the achievement of any sort of world unity, there have been examples of world-wide co-operation within limited spheres of action to offer gleams of hope. The work of the League of Nations on sociological problems has been obscured by its failure in the political sphere; the International Postal Union has been a notable example of co-operation; and most interesting of all, by reason of its potentialities as much as of its achievements, is the International Institute of Agriculture.

The inception of this Institute dates back to 1905. Although it did not develop into the organization envisaged by its rather fantastic founder, it does to a great extent provide the data, on the agricultural side, upon which attempts at a world economy must be based. Essentially it provides a continuous world census of agricultural production. The Institute publishes a monthly "International Review of Agriculture" with crop reports and estimates, reports on incidence of pests, and so on; and an "International Year-Book of Agricultural Statistics". It also deals with such subjects as farm accountancy, agricultural economics, and world agricultural legislation. Among its useful periodical bibliographical summaries the annual "Bibliography of Tropical Agriculture" has been found useful in libraries in India and Ceylon.

The work under review forms volumes 4 and 5 of a series of studies on the principal agricultural products of the world market, the first of which dealt with cotton, and the second and third with meat products.

World production of oils and fats, at least such production as finds a place in published statistics, is estimated to include ten million metric tons annually from vegetable sources, about four million tons of butter and perhaps two million tons of animal fats (including whale and other marine oils). The task of reviewing this enormous production and still more the corresponding consumption is made more difficult by the lack of adequate statistical material on these subjects, even for countries which have well-developed statistics for other products.

The present work, with its international list of contributors, probably covers the ground as well as possible. In any case the reviewer can obviously not pretend to have gone over in detail the entire contents of such a work, which almost falls into the class of Charles Lamb's *biblia abiblia*.

Treating these two volumes then as works of reference, the reviewer's first task is briefly to indicate their scope. The first section (which comprises the whole of the first volume—volume 4 of the general series of publications) treats of vegetable oils and fats; section two of the fats of land animals (including butter); and section three of oils and fats derived from marine animals.

In the fourth section the production and consumption of oils and fats in the principal importing countries are reviewed. The fifth section deals with industrial uses of oils and fats, and the tendencies of consumption in the various industries, especially margarine. A brief survey of prices concludes the work.

The statistical material is mostly complete to the end of 1936. Since then much has occurred to modify the conclusions drawn regarding tendencies of production and consumption. However one general tendency remains. Technical progress has been increasingly reducing various oils to one level of competition, the outstanding case being of course the method of hydrogenation which enabled whale and other oils increasingly to replace coconut and palm kernel oils in margarine. Some oils however still retain characteristics which enable

them to keep some of their special status. This is particularly true of drying oils such as linseed.

Apart from technical considerations, consuming trends have been considerably modified in recent years by political action in many countries, usually with the object of encouraging the production and marketing of home-produced oils and fats, as in the case of the United States processing tax in 1934. An interesting contribution by Dr. von der Decken in the work under review deals with the German Fat Plan. It is of considerable interest to compare this account with other published studies of the German measures such as Karl Brandt's *"The German Fat Plan and its Economic Setting"* (Stanford University, California, 1938) and R. Saladin's *"Les Matières grasses en Allemagne"* (Paris, 1938).

What modifications have taken place in India's trade in oils and fats up to 1936 may be studied in this volume; but it is not always easy to elicit the underlying causes or to visualise the effect of such changes. A general reduction of Indian exports probably corresponds to considerably increased internal consumption. India is now, for example, a net importer of copra (fortunately for Ceylon), whereas exports of Cochin copra and oil were considerable thirty years ago.

A statistical survey like the present work is perhaps necessarily impersonal and the student of any particular aspect of the subject will naturally supplement it with treatises of a less objective nature. Those interested in the economic significance of the fats must have a working knowledge of their sources and methods of production, their technical uses and their essential rôle in human and animal nutrition before tackling the data provided by such a work as that being discussed. For this purpose the reviewer cannot do better than recommend the perusal of the excellent little publication of the Food Research Institute at Stanford University, California, *"The Fats and Oils: a General View"* by C. L. Alsberg and A. E. Taylor (1928). With this equipment the economic student would be in a much better position to fit into its proper perspective the material provided by the statistician. There would follow the study of specific monographs on individual subjects. In the case of the student of India, for example, J. C. Bahl's *"The Oilseed Trade of India"* (Bombay, 1938) would provide useful later reading.

Behind compiled statistics of production and consumption there stand the individual producer and consumer, and it is a useful exercise in imagination to attempt the translation of a statistical table into human terms. It is one thing to read that castor seed from Brazil has replaced that from India by so many thousand tons; it is another to envisage what this has meant to cultivators in Hyderabad. Technical advances such as hydrogenation which have added large resources of new material to the world's supply of edible fats, may be regarded as advantageous increases of man's control over nature. The Ceylon coconut small-holder may be pardoned if he is unappreciative.

This review may thus end where it began by regarding its subject, or rather the organization responsible for the present study of its subject, as a small hopeful pointer towards a better organization of world economy by means of which scientific progress may contribute to the well-being of all.

R. CHILD.

THE TENTH INTERNATIONAL CONGRESS OF MILITARY MEDICINE AND PHARMACY

THE Congress was opened on May 7th, 1939 in the city of Washington D.C., and later held in the New York City, where it terminated on May 19th, 1939. More than thirty nations were represented at the Congress. Col. A. C. Munro, of the Indian Medical Service, was one of the delegates to the Congress.

In his address, the President of the Congress complimented the delegates from thirty-two distant countries, who had come there to lay the resources of medicine before the people of all nations, who are or who may be exposed to the greatest enemy, *viz.*, war. Medicine has no social, national or military boundaries and it has no military enemies. The President briefly referred to the triumphs of military medicine and surgery during the last War and the many problems, which still remained unsolved. He said, "In spite of the inhumanity of war, which is the most debased act of civilised man, some of the by-products of war have been beneficial. A war gives the first notice to the nation of the physical unfitness of a large proportion of its youth, much of it due to remediable defects. It serves as a warning to the nation to take an account of its state of health". He continued, "Medicine is not war-minded. Rather it ministers to the peace of mind, body and soul; if in the course of events the forces of mass brutality prevail over the gentle mandates of the prince of peace, medicine shall be ready to rescue from the wreckage of human folly."

A symposium was held under the joint auspices of the *Association of Military Surgeons* of the United States and the *Tenth International Congress of Military Medicine and Pharmacy.* The subject of the symposium was "The rôle of aviation medicine in the development of aviation". The report of this symposium is the most informative reading in the Proceedings. In it, we find a historical sketch of all the interesting researches made on the medical aspects of aviation—the symptoms produced at high altitudes, the adaptability of the physiological functions of the body to high altitudes, the attempts made to overcome the ill-effects of altitude and other important questions relating to aviation medicine.

Modern aviation is only slightly over thirty-six years old. While much work has been carried out on the mechanics of aviation, it is only recently that attention is being given to the pilot. In most of the progressive countries, minimum standards for military pilots have been drawn up and also a special medical service for aviators has been established. All the principal countries engaged in the Great War had medical departments which were integral parts of their air services. Post-War aviation medicine progressed with the development of civil airways, including passenger air transportation and air mail service. Thanks to the progress of aeronautics and the proper selection of pilots, air transportation to-day is as comfortable as that of land travel. The establishment of civil aviation created the need for civil flight surgeons. Aviation medicine is now an important and well established branch of general medicine. Owing to the phenomenal growth of air transport and the rapidly expanding military air force, Aviation Medicine is bound to occupy a prominent place as a special subject in medicine.

The various subjects discussed at the symposium were:—(1) The organisation and function of the medical services in colonial expeditions, (2) Probable casualties in war and methods of calculation, (3) Practical procedures for anæsthesia and analgesia in war surgery, (4) Organisation and function of the Military Chemico-Pharmaceutical service, (5) Emergency treatment and primary apparatus for fractures of the jaws in the war, (6) Technical specialisation of administrative officers in the medical service, and (7) Oxygen therapy and its practical use with troops on active duty.

On the tenth day of the session, held at New York City, several interesting papers, *e.g.*, "World War experiences in Turkey," "Surgical practice in Panama," "Surgical anæsthesia," "The influenza epedimic," "International agreements relating to hospital ships," "Biopsy of the lung with broncho-catheter," were read and discussed.

The delegates were treated to lavish banquets, and taken round to various places of interest, including the New York World's Fair.

All the delegates carried away with them splendid recollections of American hospitality. Col. Thomann submitted the formal invitation of his government to hold the next International Congress in Switzerland in 1941. The acceptance of the invitation by the International Committee was unanimously approved by the Congress, which expressed its thanks to the Swiss Government through its representative, Col. Thomann. Capt. Bambridge was presented with a medal in appreciation of his work in connection with the International Congress, since its foundation in 1921.

T. S. TIRUMURTI.

CENTENARIES

Stark, William (1740-1770)

WILLIAM STARK, a British physician, was born in Birmingham July, 1740. Having become an M.A. (Philosophy) of the Glasgow University in 1758 and after spending seven years at Edinburgh, he came to London in 1765 and devoted himself to the study of medicine at St. George's Hospital.

Dietetical Experiments

Under the guidance of John Hunter he took up the experimental study of blood and other animal fluids. He graduated M.D. at Leyden in 1766. In June 1769 he began a series of experiments on diet. The zeal with which he tried the experiments on his own body ruined his health.

To ascertain the effects of different quantities and kinds of food upon the human economy, Stark confined himself for periods of from four to fourteen days to certain articles of diet and carefully registered the influence which they seemed to exercise on the several functions of the body. He began for instance with bread and water; then he added to them, in succeeding periods, sugar, olive oil and milk; then he took different kinds of animal food and each in different quantities. Then he experienced with a diet of bread, honey and tea. In fourteen days this brought on diarrhoea. To remedy this he changed over to bread, cheese and rosemary. This produced a totally opposite state of the intestines with inflammation of their glands.

His *Works consisting of clinical and anatomical observations, with experiments diatetical and statical* were published in 1788.

Victim to Science

Stark's persistent pursuit of the dietetic experiments on himself made him a victim to his enthusiasm within seven months, 23 February 1770.

Ball, Robert Stawell (1840-1913)

ROBERT STAWELL BALL, an Irish astronomer, was born at Dublin 1 July 1840. He had a brilliant career at school and at Trinity College, Dublin, where he carried away many prizes, medals and scholarships. While tutor to the sons of the Earl of Rosse between 1865 and 1867, Ball had the opportunity to use the celebrated six-foot reflecting telescope of Lord Rosse. Through it he made regular observations of nebulæ and developed his interest in practical astronomy.

His Career

Ball was successively professor of applied mathematics in the Royal College of Science at Dublin (1868–1874); Andrews professor of astronomy in the University of Dublin and royal astronomer of Ireland (1874–1892); and Lowndean professor of astronomy at Cambridge. Due to the loss of his right eye, he had to give up observational work. But his reputation as a professor knew no bounds.

His Publications

In 1888 he published the well-known and much-used *Treatise on spherical astronomy*. Between 1877 and 1906 he published no less than thirteen popular books on astronomy. As a popular lecturer he came in contact with the widest circle. He delivered courses of Christmas lectures at the Royal Institution and for many years he lectured under the auspices of the Gilchrist Trust. His lecturing services were also requisitioned in America on three occasions.

As a Mathematician

While Ball was best known to his contemporaries through his popular lectures, he will be best remembered by posterity for his researches in Mathematics. As a true product of the Dublin school, his flair was along geometrical lines and all his researches were unified by his theory of screw motions. The ideas developed in twelve memoirs published at different times by the Royal Irish Academy, were later incorporated in two well-known treatises of permanent value: *Theory of Screws: a study in the dynamics of a rigid body* (1876) and *Treatise on the theory of screws* (1900). Even after these treatises were published, he further extended the subjects right up to his seventieth year through four more memoirs. These contributions have led Prof. E. T. Whittaker to rank him as "one of the two or three greatest British mathematicians of his generation".

Ball was knighted in 1886 and died at Cambridge 25 November, 1913.

S. R. Ranganathan.
University Library,
Madras.

SCIENCE NOTES AND NEWS

A Preliminary Study on Orange Fruit Rot.—Oranges from Kalimpong placed on sterilised glass plates and covered by large bell-jars, were observed to develop rot. Isolations of the fungus were made by planting bits of diseased rind in tubes of potato-dextrose agar, Czapeck synthetic agar medium and Coon's medium. The pathogenicity of isolates was tested by inoculation of healthy orange fruits.

The following is the list of species of fungi thus isolated in pure culture: (1) *Penicillium expansum* Link. (2) *Penicillium italicum* Wehmer. (3) *Penicillium digitatum* Sacc. (4) *Aspergillus niger* Van Tiegh. (5) *Cladosporium herbarum* var. *citricolum* F. & B. (6) *Trichoderma lingorum* (Tode) Harz. (7) *Colletotrichum gloeosporioides* Penz. (8) *Alternaria citri* Pierce. (9) *Botrytis cinerea* Pers. (10) *Fusarium moniliforme* Sheldon. T. C. ROY.

Rôle of Coenzymes in Dehydrogenase Systems.—In the cozymase-dependent dehydrogenase systems, the coenzyme functions essentially as a reversible hydrogen acceptor. Thus in the alcohol dehydrogenase system, the chain of reactions leading to the oxidation of alcohol may be pictured thus: The substrate (alcohol) combines with a specific group in the dehydrogenase to form a dissociated compound; similarly, the cozymase also forms a dissociated compound with the dehydrogenase; two atoms of hydrogen pass from the alcohol to the cozymase; the latter reacts with the flavoprotein and gets reduced; fresh units of alcohol and cozymase combine with the dehydrogenase and the process goes on. The reaction is reversible, so that the group in the dehydrogenase protein which combines with the alcohol also combines with the aldehyde and the same is true of the oxidised and reduced cozymase.

Two views have been advanced to interpret these facts: according to the first, the relation of the dehydrogenase to coenzyme is that of an enzyme to its substrate; the reaction does not differ fundamentally from the other bimolecular reactions catalysed by enzymes. According to the other view, cozymase is the prosthetic group of the dehydrogenase protein and it is this "Pyridine-protein" complex that functions as the active enzyme. According to this view cozymase is regarded neither as a substrate nor as a coenzyme in the strict sense of these terms. This view offers a unified conception of the oxidising enzymes, catalase and peroxidase and more particularly the diaphorase and amine oxidase.

The recent work of Dixon and Zerfas (*Biochem. J.*, 1940, **34**, 371) is of particular importance in understanding the rôle of cozymase in the dehydrogenase systems. These workers have made an extensive study of 2 typical dehydrogenase systems employing a wide range of H-acceptors. For the first view to be tenable, H-acceptors should be available which are directly reduced by the oxidised substrate without the intervention of cozymase. If the second view is correct, no matter what acceptor is employed, under no condition is it reduced unless cozymase is also present. Dixon and Zerfas tested the ability of the alcohol and malic dehydrogenases of yeast—2 typical dehydrogenases which are known to act through cozymase and of which coenzyme-free preparations can be prepared—, to reduce a variety of H-acceptors—dyes, quinone, alloxan, iodine, hydrogen peroxide and aromatic nitro compounds, with and without cozymase. As a result of this study, they showed that acceptors, alloxan, iodine, hydrogen peroxide and dibromophenolindophenol are capable of being reduced by activated substrates in the *absence* of cozymase or flavoprotein. This leads to the important conclusion that the relationship between the dehydrogenase and cozymase is that of an enzyme to its substrate and not that of a "protein" to its prosthetic group. There are a number of arguments against the acceptance of the view that cozymase functions as the prosthetic group of the dehydrogenase. It should be made clear, however, that the substances which function *like* cozymase as direct H-acceptors do not equal cozymase in efficiency.

P. R. V.

Breeding of the Stork.—It is well known that the nest-building habit amongst birds is extremely fascinating because of the variety it exhibits. The bigger birds must naturally build a strong nest for the parent bird to sit and incubate. In the painted Stork *Ibis*, Weinman records [*Ceylon J. Sci.*, 1940, 22 (B)] that a pair succeeded in building a rough and untidy nest with a lining of feathers in a week's time. Three eggs were laid and were incubated by the female in the morning and during nights the male took charge. Eggs were rolled from time to time by the beaks and the nestlings appeared after a lapse of 28 days. Unfortunately, when the parent birds left for foraging food, the predacious crows made short shrift of the nestling. A new family was raised by the same pair almost a few days after the bereavement. The young bird was fed by the parents for nearly three months and when it commenced to take aerial reconnoitres, it stood nearly 18 inches in height. It is remarkable that in these Ibises which generally breed in colonies in mangrove and other trees, the powerful instinct of breeding manifests and is successfully carried out even under domestication.

The Morphology of the Human Sperm and Egg.—Gatenby and Aykroyd's paper (*Proc. Roy. Irish Acad.*, **46**, Sec. B, 39) is devoted to a critical discussion of a recent work by Popa and Marza on the structure of the human sperm. On account of its minuteness as well as on account of the different methods that have been employed to study it, the human sperm still

remains an object of conflicting interpretations and the present authors attempt to say the last word on it. According to them the human sperm examined after proper treatment consists of ten parts,—acrosome, nucleus, post-nuclear cup, neck granule, neck, proximal centriole, middle piece, distal centriole, tail and flagellum. Many of the structures reported by Popa and Marza, like the middle piece bead and the sensillæ amœboidæ, are believed to be nothing other than artefacts and are not true parts of the human sperm.

The human egg is interesting in regard to the distribution of the cytoplasmic elements. The golgi bodies and the mitochondria occupy two distinct zones in the cytoplasm,—the former, peripheral, and the latter, central. There is no neutral fat, nor is there any yolk in it.

Mango Budding.—As may be well known, the most successful and commonly practised method of propagating the mango vegetatively is by means of grafting and not by means of budding as in the case of most other fruit or flower plants. The grafting too is a variation of approach grafting which goes by the name of inarching. As the result of much experimental work Burns and Prayag concluded that in the mango, budding was an uncertain means of propagation and that in India, it therefore could not be recommended. Recent work, however, carried out in Sind shows that budding can be very successfully effected in the mango, just indeed as effectively as in the case of other plants. Success in budding the mango on the Government Fruit Farm, Mirpurkhas, Sind, now scores at 60 per cent. and during the years 1937, 1938 and 1939 over 700 budded plants were also distributed to the public (Ali Mahomed Ulvi, *Indian Farming*, May 1940). Full details of the technique of the process are given in the article including nursery raising, suitable season for budding, selection and treatment and insertion of the bud, etc.,—all applicable of course to Sind conditions. There is nothing special or complicate in the technique, climatic and other local conditions being apparently responsible for this welcome success. It may be a useful line of work in the South Indian and other Fruit Stations to repeat the work under their conditions, now that the success of the process has been demonstrated, albeit in a different part of India.

A. K. Y.

Ten years of research on the influence of manures on the quality of crops, at the *Imperial Agricultural Research Institute*, has led to the important conclusion that manures and fertilisers are capable of influencing the composition and quality of the crop to such an extent as to appreciably affect its value as seed and as food. This finding is of great importance both from the scientific and practical points of view. The need for research on a rational system of manuring the soils and crops to the best advantage becomes clear. In a country like India, where a great majority of soils are poor in organic matter and where in many cases, one variety of grains form the bulk of the diet of the major part of the population, this work carried out at the Institute is of special importance.

Monograph on the Ox.—The Advisory Board of the *Imperial Council of Agricultural Research* at its 21st meeting held in Simla on June 27–29 has approved of the grant of funds for the preparation of a critical monograph on the Anatomy of the Ox. No text-book, devoted specially to the anatomy of the ox, has ever been produced anywhere and it is considered that such a text-book is desirable in view of the importance of the ox in India.

The Central Committee of the **Tuberculosis Association of India** has released to the public, the scheme for "the control of tuberculosis by organised home treatment". The principle behind the tuberculosis campaign in India must be to search out "the tuberculous patients in order to fight the disease wherever it exists and is spreading, and it needs the following five main activities for a successful working:—(1) the tuberculosis clinic, (2) institutional treatment for a certain number of selected patients, (3) close co-operation between the clinic and the private practitioners, (4) care and after-care committees to work in connection with the clinics and other tuberculosis institutions, and (5) colonies or settlements for tuberculosis ex-patients. Copies of the pamphlets can be obtained from the Secretary, *Tuberculosis Association of India*, 20, Talkatora Road, New Delhi, free of charge, on request.

The Health Organisation of the League of Nations is considering the constitution of an **International Documentation Centre for Health Matters.** According to the latest issue of the *Chronicle of the Health Organisation* "the Service of Epidemiological Intelligence and Public Health Statistics has, in the past, frequently had to reply to requests for documentary material received in the most varied forms from the public authorities of various countries, and relating usually to the health conditions of some particular region, to the course of prevailing epidemics or to recent demographic data. For some time past, such requests for information have shown a tendency to increase, and even to overstep the limits of the Health Organisation's work. During the first six weeks of 1940, 21 requests of this kind were answered. They came from governments, public health departments, specialists and professors of faculties of medicine, and from various bodies.

"The result, as can well be realised, has been an increase of work; but it is of undoubted utility. The decision has accordingly been taken gradually to build up a documentation centre, the organisation and control of which have been entrusted to Dr. Biraud. In the present circumstances, obviously, all that can be done is to prepare for the future, by making arrangements for the classification and utilisation of the documentary material in the hands of the Health Organisation. The service is thus one which is still in embryonic form, but should

normally be capable of development when circumstances permit."

Indian Eugenics Society.—An Indian Eugenics Society has been formed with its office at Calcutta. The Society aims at furthering the principles of human genetics and racial hygiene and their practical applications for the betterment of the Indian population with a view to enhance its surviving capacity in the struggle for existence. The Society seeks to promote scientific research in the fields of Racial and Social Biology, to spread the knowledge of racial biology and hygiene as well as the practical rules of conduct following therefrom among the people. The Society will work in co-operation with other scientific bodies working in the field of Eugenics, like the International Human Heredity Committee, London, the International Commission of Eugenics, America, etc.

The Society proposes to publish bulletins from time to time and arrange for popular lectures in different centres. The Society will also carry out investigations of medico-legal and criminological nature on behalf of recognised bodies or *bonafide* individuals.

A booklet entitled "A Plea for Eugenic Researches in Bengal" discussing the various eugenic problems of the country will shortly be published by the Society.

Dr. B. K. Chatterji, D.Sc. (Paris), is the President of the Society. The office of the Society is at present located at 60/1 B, Chakraberia Road North, Calcutta.

The General Secretary will be glad to give all necessary information to the interested public.

Sugar Industry in India (1938-39).*—During the year 1938–39, the output of sugar and gur in India was considerably lessened over the previous year's output. Only 139 factories out of 158 existing in India, worked directly with cane and produced 650,800 tons of white sugar as against 930,000 tons of the previous year, showing a decline of 30 per cent. Inclusive of sugar from gur refining, and khandasari sugar industry the total sugar production was 766,000 tons which is about 3 lakhs of tons below the normal consumption requirements of the country. Again, the net production of gur was 2,728,000 tons as against 3,364,000 tons of the preceding season. This remarkable short production of both white sugar and gur is due mainly to scarcity of cane supply as a result of reductions in the acreage under cane and extensive damage to crop in the U.P. and Bihar. The cane was also of poor quality in parts of the U.P. and Bihar owing to diseases and floods.

A similar decline in molasses trade was also noticed. The total production of molasses in India during 1938–39 was 350,000 tons as against 484,000 tons during the corresponding previous year. Of this, 242,300 tons were produced in central sugar factories while the figure for the previous season was 349,600 tons. The imports of molasses by sea into India in 1938–39 was 2,160 tons as against only 5 tons in the previous season.

During the period under review the output of cane in India fell by over 22 per cent. from 55,600,000 tons in 1937–38 to 43,100,000 tons.

The Sugar Industry (Protection) Act of 1932 had directed instituting a further enquiry on the sugar industry regarding the rate of protection for the period 1–4–38 to 31–3–1946. Accordingly, the question was referred to the Tariff Board which submitted its report in December 1937. The recommendation of the Board for the continuance of the existing rate of protection (namely Rs. 7–4–0 per cwt.) till March 1946 was not accepted by the Government who however decided on the reduced rate of protection of Rs. 6–12–0 per cwt. until April 1941, and the measure of protection for later periods was to be fixed after a further enquiry. The excise duty on Khandasari sugar was reduced from Re. 1 to As. 8 per cwt. withdrawing simultaneously the exemption from this duty enjoyed hitherto by concerns employing less than 20 persons.

The yield of revenue from excise duty on sugar in 1938–39 was Rs. 4,22,44,491 on white sugar and Rs. 58,607 on Khandasari sugar, against Rs. 3,30,96,902 and Rs. 50,427 respectively in 1937–38.

Owing to the short production in 1938–39 the sugar prices moved up and made possible the imports of sugar from Java to fill the gaps in home production. The quantity of sugar thus imported was 24,510 tons as against 10,293 tons of last year.

The consumption of sugar in India in the crop year 1938–39 has been estimated at 1,083,000 tons as against 1,159,000 tons in 1937–38 and 1,167,000 tons in 1936–37.

The rising level of sugar prices enabled the governments of U.P. and Bihar to fix minimum prices for cane and these prices were substantially increased during the season to keep pace with the rise in sugar prices. The higher prices thus given for cane diverted large quantities of cane to sugar factories from gur industry with the result that the production of sugar in the season 1939–40 is likely to be much larger than was estimated at the beginning of the season and this is expected to bring down the sugar prices.

G. G. Rao.

Money and Banking 1939/40.—The latest Monetary Review more usually referred to as "a veritable blue-book of international finance" issued by the *League of Nations* (Ser. L.o.N.P., 1940, II, A 2/I, pp. 104, Price 3*sh.*) is of particular interest and will be indispensable to everyone wishing to keep abreast of the far-reaching changes brought about by war in the world's monetary mechanism. According to a note issued by the Information Section of the League, the *Review* describes "the various Government measures adopted since September 1939 to control the exchanges and to mobilise foreign assets, to deal with the abnormal demand for liquidity in general and for notes and coins in particular, and to meet the exceptional

* From a 'Review' by R. C. Srivastava, in a Supplement to the *Indian Trade Journal*, May 30th, 1940.

loan requirements of the State; and it examines the influence of these various factors on the monetary supply and on the cost of credit.

"The first chapter presents, more especially, a survey of recent movements in exchange rates and a comprehensive analysis of the war-time restrictions on foreign payments and capital transfers. The second is mainly concerned with the war-time liquidity problem and with the measures taken, according to circumstances, to check or to satisfy the demand for liquid resources and means of payment. Stock Exchange and banking regulations are discussed in this connection, as well as moratoria and special credit facilities, issues of new kinds of currency, and changes in central bank legislation designed to remove the traditional limitations on the note issue.

"There follows a chapter on war finance and the money market, describing the methods of Government borrowing in a large number of countries, and calling special attention to the part played by central and commercial banks in Government financing. The fourth chapter deals with the resulting expansion in the volume of currency and credit, and points out significant movements in discount rates, bond yields and share prices. Recent currency measures in Czecho-Slovakia, Danzig and Poland are summarised in a supplementary note."

The Breeding of Herbage Plants in Scandinavia and Finland.—Arrangements have been made between the various Imperial Agricultural Bureaux whereby any publication upon the preparation of which two or more Bureaux collaborate shall be included in a new series entitled Joint Publications. It has been decided to regard the earlier Joint Publications on "Vernalization and phasic development of plants" and "Erosion and soil conservation", as Nos. 1 and 2 in this series. Other Joint Publications produced in recent years but already out of print have not been given numbers in the series.

The *Imperial Bureau of Plant Breeding and Genetics* and the Imperial Bureau of Pastures and Forage Crops have now produced Joint Publication No. 3, entitled "The breeding of herbage plants in Scandinavia and Finland". It is a symposium consisting of a series of articles by acknowledged specialists in the respective countries. G. Nilsson-Leissner, F. Nilsson, E. Åkerberg and R. Torssell contribute articles on work in Sweden, H. N. Frandsen, H. Wexelsen and O. Pohjakallio on Denmark, Norway and Finland respectively. Each article reviews recent developments in the countries concerned, including details of the most recent improved strains of grasses, clovers and lucerne, and the methods used in producing them, as well as a contribution on the application of cytology to herbage plant breeding. The articles vary from 5 to 35 pages in length and are mostly quite detailed, each being provided with a mass of tabular data and selected bibliographies. The Scandinavian countries are recognized authorities on grassland and breeding problems and the bulletin provides an invaluable outline of achievements up to date. This is made specially clear by a useful summary of the entire contents of the bulletin which appears at the beginning, before the presentation of the individual articles. Another useful feature is the provision of a list of addresses of the research stations concerned and of maps illustrating their locality.

The bulletin covers some 125 pages and is obtainable from either Bureau at the moderate price of 4*s*. Standing orders for Joint Publications should be placed with the *Secretary, Imperial Agricultural Bureau, 2 Queen Anne's Gate Buildings, London, S.W. 1.*

In his recent Presidential Address to the **Mining, Geological and Metallurgical Institute of India**, Mr. J. B. Ross, M.I.C., deals with the economic problem of the coal trade as it exists to-day, viewed from the administrative point of view. After giving several facts and figures relating to the present conditions of the coal industry in India, he urges the need for a Central Committee elected by and representing the different associations interested in the coal trade. The appointment of such a Committee represents in his view, "a step in the right direction towards co-operative thinking and action of which the trade stands so badly in need, and which the present diversity of interests makes so difficult of attainment."

The Annual Report presented to the General Body by the Hon. Secretary gives an account of the various activities of the Institute during the year. On the recommendation of the Judging Committee the following Prizes and Medals were awarded: (*a*) The Government of India Prize of Rs. 500 to Mr. B. Wilson Haigh for his paper entitled "Coal Carbonisation and Some of its By-products"; one Institute Silver Medal to Dr. F. G. Percival and Dr. E. Spencer for their joint paper on "Conglomerates and Lavas in the Singhbhum—Orissa Iron Ore Series"; one Institute Silver Medal to Dr. M. S. Krishnan for his paper on "Mineral Wool"; one Institute Bronze Medal to Dr. D. Swarup, Mr. V. G. Iyer, and Mr. A. H. K. Iyer, for their joint paper on "An Investigation into the Possibilities of Manufacturing Carbon Electrodes in India"; and one Institute Bronze Medal to Mr. L. J. Baraclough for his joint paper with Mr. S. B. Hall on "Hydraulic Stowing in India: Obtaining Supplies of Sand."

Indian Chemical Manufacturers Association.—The first Annual Report of the activities of the Association is an interesting and thought-provoking volume. The Association has about 25 important manufacturing firms from all parts of India on its membership roll and has been doing a lot of useful work during the short period of its existence. The chemical industry in India is suffering from a number of difficulties and one of the objects with which the Association was started, was to draw the pointed attention of the government to these difficulties and suggest means of overcoming them. The Association has been tackling such important questions as the varying rates of excise duty

in the various provinces (leading to difficulties in movement of goods), high railway freight on chemical and allied products, high import duties on raw materials for the chemical industry, the urgent need for introducing a comprehensive act to control the drug industry and the desirability of curtailing the activities of the Government Medical Stores Departments. The Association has been corresponding with the Government of India, the Provincial Governments, the Railway Authorities, etc., on these matters. Most of the problems which have been dealt with by the Association are connected with the pharmaceutical industry which is perhaps the best established branch in India of the chemical industry. It is true that most of these grievances are still to be redressed; but this is due to the indifference and apathy of the authorities and the Association deserves all credit for the fight it has put up on behalf of the industry. The Association has given valuable advice to the Government of India regarding the new Drug Act which was passed recently. It has also taken up the question of scarcity of raw materials required for pharmaceutical and other chemical industries which has resulted after the outbreak of war. The members of the Association were requested to give lists of raw materials they require and the possibility of manufacturing some of these was also discussed. The Association has many other useful activities to its credit and is fulfilling a most important function. If its membership increases as it is bound to do, it will help the chemical industry in India to present a united front.

C. V.

The Annual Report of the **Mysore Civil Veterinary Department** for the year 1938–39, which has just been issued, is a valuable record of the very useful work undertaken by the Department in connection with the improvement of live-stock and the prevention and spread of contagious diseases of animals. There were stray outbreaks of rinderpest disease all over the State; systematic inoculation campaigns were carried out and the disease was brought under control. The Veterinary Research Officer, Dr. P. M. N. Naidu, carried out investigations on the etiology of many diseases prevalent in the State. The new Saponin vaccine for the treatment of anthrax, prepared by him, was experimented in several places with very encouraging results. Some 839 animals including sheep, goats, lambs and kids were protected by the vaccine. At the request of the Chief Commandant, Mysore State Troops, investigations into the cause of sterility and frequent abortions among the stud mares at the Kunigal and Hessaraghatta Farms were undertaken. The scheme of investigation into the Johne's disease financed by the Imperial Council of Agricultural Research was extended for a further period of two years.

The Madras University has awarded the Degree of Doctor of Science to Mr. A. Narasinga Rao, M.A., L.T., Professor of Mathematics, Annamalai University.

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ASTRONOMICAL NOTES

Planets during August 1940.—Venus continues to be a very bright object visible in the eastern sky for over three hours before sunrise. On August 2, the planet will be at its greatest brilliancy, the corresponding stellar magnitude being −4·2. Mercury is in the morning sky, and on August 10 reaches greatest elongation west of the Sun (18° 57′) when it will be rising about an hour before sunrise. Mars continues to approach the Sun in the evening sky and after reaching conjunction with the Sun on August 30, passes into the morning sky.

Both Jupiter and Saturn will be near the meridian at sunrise and are well placed for observation during the latter part of the night. The two planets will be in conjunction with each other on August 15, when the angular distance will be only about a degree and a quarter. Saturn will reach one of the stationary points of its geocentric orbit on August 27, and will begin to move in a retrograde direction among the stars. Uranus is slowly moving eastwards in the constellation Taurus and can be seen as a sixth magnitude star about five degrees south of the open cluster Pleiades. It will be in quadrature with the Sun on August 19.

The Perseids: One of the most important meteoric showers is the Perseids which occur regularly every year in August, the date of maximum display being about August 12. The radiant point is situated in R.A. 47°, Declination 57° North, about 7° to the north of the second magnitude star α Persei.

T. P. B.

Lady Tata Memorial Trust.—The award of the following scholarships for the year 1940–41 has been announced: (1) Mr. K. Ganapathi, B.A., M.Sc. (Synthesis of compounds of sulphanilamide group), (2) Mr. T. J. Job, B.A., M.Sc. (The practical utility of insectivorous fishes in the biological control of mosquitoes), (3) Mr. Manmatha Kumar Haldar, M.Sc. (Anemia with special reference to the hæmopoietic factors and the availability of iron from different sources of hæmoglobin formation), (4) Dr. Saschchidananda Bannerji, M.Sc., M.B. (The comparative methods for determining the Vitamin C status of the body and the rôle of Vitamin C in infection) and (5) G. B. Ramasarma, B.Sc. (Hons.), A.I.I.Sc. (Investigations on Vitamin A, specially provitamins and the rôle of fat in their absorption).

MAGNETIC NOTES

The magnetic activity during June 1940 was on the whole similar to that during the previous month. There were 9 *quiet* days, 19 days of *slight* disturbance, one day of *moderate* disturbance and one of *great* disturbance as against 6 quiet days, 23 days of slight disturbance and one day of great disturbance during June 1939.

The day of largest disturbance was the 25th when a magnetic storm of great intensity was recorded. The quietest day was the 1st. The characterisation of individual days is shown below.

Quiet days	Disturbed days		
	Slight	Moderate	Great
1, 10-13, 20, 21, 27, 30	2-9,15-19, 22-24, 26 28, 29	14	25

During the month there was only one storm and that of great intensity as against one storm also of great intensity recorded during June of last year. The mean character figure for the month is 0·77 while that for June 1939 was 0·83.

M. R. RANGASWAMI.

SEISMOLOGICAL NOTES

During the month of June 1940, one slight and one moderate earthquake shocks were recorded by the Colaba seismographs as against one slight and three moderate ones recorded during the same month in 1939. Details for June 1940 are given in the following table:—

Date	Intensity of the shock	Time of origin I. S. T.	Epicentral distance from Bombay	Co-ordinates of the epicentre (tentative)
		H. M.	(Miles)	
June 5	Slight	16 31	6290	
,, 22	Moderate	17 07	3390	Near 1°·5 N., 120°·0 E., in Celebes Sea

ANNOUNCEMENTS

The Second Session of the *Tuberculosis Workers' Conference* will be held in November 1940 in New Delhi. The exact date of the Conference and the programme therefor, will be announced in due course.

The fourth Special Tuberculosis Number of the *Indian Medical Gazette* will be issued in October 1940. Some of the distinguished tuberculosis workers in the country have agreed to contribute papers on clinical and preventive aspects of the problem.

The attention of our readers is drawn to the advertisement appearing elsewhere in this number calling applications from duly qualified candidates for the post of Director of Fisheries, Ceylon. The post carries a salary of Rs. 10,800 per annum rising by annual increments of Rs. 600 to Rs. 14,400. Last date of application August 20, 1940.

We acknowledge with thanks the receipt of the following:—

"Journal of the Annamalai University," Vol. 9, No. 3.

"Agricultural Gazette of New South Wales," Vol. 51, Pt. 6.

"Journal of the Royal Society of Arts," Vol. 88, Nos. 4560–61.

"Allahabad Farmer," Vol. 14, No. 4.

"Biochemical Journal," Vol. 34, No. 4.

"Journal of the Institute of Brewing," Vol. 44, No. 5.

"Journal of the Indian Botanical Society," Vol. 18, Nos. 4–6.

"Contributions from Boyce Thompson Institute," Vol. 11, No. 2.

"Journal of Chemical Physics," Vol. 8, No. 5.

"Russian Journal of Chemistry," Vol. 10, Nos. 1–2.

"Experiment Station Record," Vol. 82, No. 4.

"Indian Forester," Vol. 66, No. 7.

"Transactions of the Faraday Society," Vol. 34, No. 229.

"Genetics," Vol. 25, No. 3.

"Quarterly Journal of the Geological, Mining and Metallurgical Society of India," Vol. 11, No. 3.

"Bulletin of the Indian Central Jute Committee," Vol. 3, No. 3.

"Proceedings of the Royal Irish Academy," Vol. 45, B. 17; Vol. 46, B. 1–3.

"Bulletin of Health Organisation (League of Nations)," Vol. 9, No. 1.

"Chronicle of Health Organisation (League of Nations)," Vol. 2. No. 4.

"Transactions of the Mining, Geological and Metallurgical Institute of India," Vol. 36, Pt. 1.

"Review of Applied Mycology," Vol. 19, Pt. 5.

"Journal of the Indian Mathematical Society," Vol. 4, No. 2.

"Indian Medical Gazette," Vol. 75, No. 6.

"Acta Physicochimica," Vol. 12, No. 1.

"National Academy of Sciences, Proceedings," Vol. 9, Pts. 2 and 3.

"Journal of Nutrition," Vol. 19, No. 5.

"Nature," Vol. 145, Nos. 3679–82.

"Canadian Journal of Research," Vol. 18, No. 5, A, B, C, D.

"Ceylon Journal of Science," Vol. 22, Pt. 1.

"Sky," Vol. 4, No. 7.

"Indian Trade Journal," Vol. 137, Nos. 1773–75 and Vol. 138, No. 1776.

ACADEMIES AND SOCIETIES

Indian Academy of Sciences *(Proceedings)*:

June 1940. SECTION A.—SIR C. V. RAMAN AND V. S. RAJAGOPALAN: *Colour of Stratified Media —I. Ancient Decomposed Glass.* Brewster's explanation of the iridescence as due to films of air separating thin layers of glass is definitely erroneous. The material is optically and mechanically continuous, but has an open framework structure which is quasi-periodic or stratified. Nine microphotographs and twelve spectrograms illustrate the paper. SIKHIBHUSHAN DUTT: *Colour in Relation to Chemical Constitution of the Phthalein Dyes. Phthaleins of the Mixed Type.* The colour phenomena exhibited by the unsymmetrical and symmetrical phthaleins on treatment with alkali are quite comparable with similar phenomena exhibited by iso-nitroso-1 :3-diphenyl-thiohydantoin and iso-nitroso-1 :3-diphenyl-thiobarbituric acid under identical conditions as studied by Dutt and his pupils, and due to the same cause. A. NARASINGA RAO: *Studies in Turbine Geometry—IV. The Topology of Oriented and Non-oriented Line Elements in the Inversive Plane.* B. RAMAMURTI: *A Geometrical Proof of a Theorem of Spinors.* K. SAMBASIVA RAO: *Generalisation of a Theorem of Pillai-Selberg.* T. R. SESHADRI AND J. VEERARAGHAVIAH: *Chemical Investigation of Indian Fruits—Part I. Bitter Principles of Pamparapanas (Indian Shaddock).* The peels and rags contain 0·13% and 1% respectively of naringin. The seeds contain 0·15% naringin and about 0·6% of limonin and some isolimonin. N. W. HIRWE, K. D. GAVANKAR AND B. V. PATIL: *Studies in Chloralamides—Part II. Chloral Nitro- and Chloral Bromo-Salicylamides.*

June 1940. SECTION B.—I. FROILANO DE MELLO: *Experimental studies on diets deficient in Vitamin B and their influence on the intestinal yeast flora of animals.* Yeast infestation of the intestines of animals should be considered as a case of normal commensalism. The variations in the degrees of such an infestation may, however, be taken as an analytic test for deficiency arising from beriberigenic diets. There is a large increase in the number of yeasts when the animals are placed on beriberigenic diets, and the number generally decreases to the normal health level when the animals suffering from experimental avitaminosis are fed on normal diet. B. N. SINGH AND M. P. SINGH: *Diurnal march of carbohydrates in relation to biochemic constitution of leaves.* S. L. VENKITESWARAN AND M. SREENIVASAYA: *On Tyrosinase of* Dolichos lablab*—I. Methods of estimation and the oxidation of different substrates.* The general substrate specificity of the enzyme suggests that it is not a "laccase", since the enzyme preparations have been found to be inert towards p-dihydroxy compounds. C. SRIKANTIA, C. KRISHNASWAMI RAO AND T. PRASANNASIMHA ROW: *Glutathion in anæmias. Its variations in the blood and its relation to the erythrocyte count and hæmoglobin content.* There is a marked increase in the corpuscular glutathion in anæmias generally and in ankylostome anæmias the increase is higher. SHRI RANJAN AND V. R. JHA: *The effect of ethylene and sulphur dioxide on the fruits of* Mangifera indica. The physiology of the black tip disease of mangoes has been studied.

National Academy of Sciences *(Proceedings)*:

May 1939.—SIR SHAH SULAIMAN: *The theory of a new relativity, Chapter XVI (Generalised Gravitation).* GIRJA DAYAL SRIVASTAVA: *Contribution to the morphology of* Orobanche ægyptiaca *Pers.* SIKHIBHUSHAN DUTT: *Composition of patent still molasses fusel oil of Indian origin—Part II.* JAGAT NARAIN TAYAL AND SIKHIBHUSHAN DUTT: *Chemical examination of the seeds of* Martynia diandra. *Composition of the fixed oil.* JAGRAJ BEHARI LAL: *Constitution of santalin.* A. B. SEN: *Migration of para halogen atom in a derivative of meta-cresol.* IONE NITRAVATI DHARAM DASS AND SIKHIBHUSHAN DUTT: *Colour in relation to chemical constitution of the organic and inorganic salts of iso-nitrosomalonyl-guanidine.*

August 1939.—RAM KRISHNA MEHRA: *New monostomes of the family pronocephalidæ looss,* 1902. R. N. MITTRA: *Formation of periodic precipitate in the absence of a foreign gel—Part III. Ferric phosphate and ferric arsenate sols.* R. N. MITTRA: *Formation of periodic precipitate in the absence of foreign gel—Part IV. Ferric borate sol.* S. N. BANERJI AND S. GHOSH: *Changes in the viscosity of agar sol with concentration.* S. N. BANERJI AND S. GHOSH: *Changes in the viscosity of agar sol with temperature.*

Mining, Geological and Metallurgical Institute of India (*Transactions*):

The recent number of the *Transactions of the Mining, Geological and Metallurgical Institute of India* (Vol. 35, Pt. 4, February 1940) contains three important papers; one by DRS. F. G. PERCIVAL AND E. SPENCER on *Conglomerates and Lavas in the Singhbhum-Orissa Iron Ore Series;* the second by MR. B. WILSON HAIGH on *Coal Carbonisation and Some of its By-products,* and the third on *Mineral Wool* by DR. M. S. KRISHNAN. The first paper deals with certain aspects of the geology of an area which has been attracting considerable attention within recent years. The second paper gives an account of the carbonisation of coal at high, medium and low temperatures, with special reference to the by-products derivable therefrom. The paper on Mineral Wool by Dr. M. S. Krishnan is of exceptional interest, and from

what the author says, it is clear that there is a vast field in India for the production and utilisation of 'rock wool', forming the basis of a new and useful industry.

The Journal also contains a Report of the Discussion on Mr. M. M. Mukherji's paper on the *Correlation of the Satpukuria Seam in the Raniganj Coal Field.*

Geological, Mining and Metallurgical Society of India (*Journal*):

The latest number of the *Quarterly Journal of the Geological, Mining and Metallurgical Society of India* (Vol. XI, No. 3, September 1939), begins with the Annual Report of the work done by the Society during the year 1938–39, which is followed by the Presidential Address by Jhaveri Lal K. Dholakia on National Planning in relation to Geology, Mining and Metallurgy, in which he gives a review of the present position in the matter of mineralogical and metallurgical industries in India and indicates the lines on which further developments should proceed. The *Journal* also contains 5 other short papers of interest among which may be mentioned *A Note on the Metamorphic Rocks in Southern Konkan* by MESSRS. K. V. KELKAR AND W. P. PATANKAR; *Micro Structure of Some Indian Fusain* by MR. N. N. CHATTERJI, and *Geology of the Chromite Deposit of Jojohatu, Singbhum* by MR. B. S. BAHADURIA. The Secretaries' Report is a record of much useful work done by the Society during the year in Geology and allied branches of knowledge.

Indian Botanical Society (*Journal*):

June 1940.—R. E. COOPER AND R. R. ULLAL: *The study of the effect of a mixture of two parts of blue-violet rays and one part of white light on the formation of carbohydrates in leaves.* A. M. SUBBA RAO: *Studies in the Malpighiaceæ—I. Embryo-sac development and embryogeny in the genera* Hiptage, Banisteria *and* Stigmatophyllum. L. B. KAJALE: *A contribution to the life-history of* Bergia ammanioides *Roxb.* SULTAN AHMAD: *Higher fungi of the Punjab plains—II. The Gasteromycetes.* C. V. KRISHNA IYENGAR: *Development of embryo-sac and endosperm-haustoria in some members of Scrophularineæ—IV.* Vandellia hirsuta *Ham. and* V. scabra *Benth.* M. O. P. IYENGAR: *On the formation of gametes in Caulerpa.* M. O. P. IYENGAR AND K. R. RAMANATHAN: *On sexual reproduction in a Dictyosphærium.* B. SAHNI: *Palæobotany in India—Progress Report for* 1939. P. R. BHAGAVATHI KUTTY AMMA AND T. EKAMBARAM: *Sugarcane × Bamboo hybrids.* S. C. DIXIT: *The Charophytes of the Bombay Presidency—II.* D. P. MULLAN: *The Anatomy of* Spinifex squarrosus *Linn. with special reference to the morphology of the leaf-blade.*

Royal Asiatic Society of Bengal:

July 1, 1940.—D. N. MAJUMDAR: *Some aspects of the cultural life of the Khasas of cis-Himalayan region.* The Khasas of Jaunsar Bawar, included in the Chakrata subdivision of the Dehra Dun District in the United Provinces, are a polyandrous people. There is ample evidence of the physical similarity of the Khasas with the Kashmiris, and the Khasa family law resembles the Punjab customary law, particularly that of the Kangra hills. They represent, most probably, the easternmost outpost of Indo-Aryan penetration in the *cis*-Himalayan region. The social organization in Jaunsar Bawar is characterised by a dual organization of economic classes, *viz.*, the zemindars and the artisans. The latter are mostly recruited from the aboriginal substratum perhaps of "Austric" speaking stock. Religious life of the Khasas is a curious blend of Hindu and tribal beliefs and practices and though they own allegiance to Hindu divinities their partiality to ancestral spirits, queer and fantastic demons and gods, stones, weapons and various symbols, is rather phenomenal. The Khasas are a patriarchal people living in a joint family under the authority of the eldest brother. The polyandry of the Khasas is also of the fraternal type. There is a disparity in the distribution of the sexes and the fertility of women has considerably fallen in recent years: the proportion of the male children is greatly in excess of females. The functional analysis of the group morals and customs connected with polyandry leads to the irresistible conclusion that the *cis*-Himalayan region is characterised by an impact of two distinct matrices, one matriarchal represented by the Domas or the aboriginal substratum and the other patriarchal represented by the Khasas.

Among other papers read at the meeting, mention may be made of the paper by Dr. A. Aiyappan, on "Siva-Seal of Mohenjo-Daro".

Meteorological Office Colloquium, Poona:

June 11, 1940.—A. K. ROY: *Application of Wet-bulb potential temperature to Airmass analysis.*

June 18, 1940.—B. N. DESAI: *The results of analysis of surface and upper air data relating to a Bay storm of November* 1935.

June 25, 1940.—C. P. MENEZES: *The currents of the Indian ocean.* S. N. ROY-CHOWDHURY: *Sea-breeze at Karachi.*

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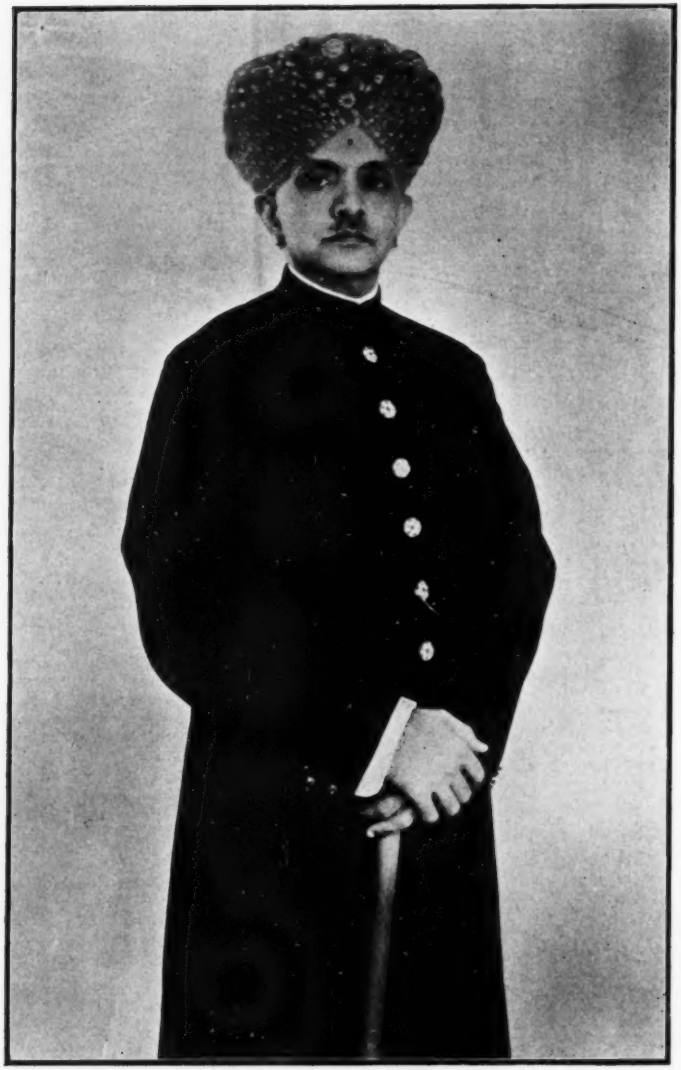
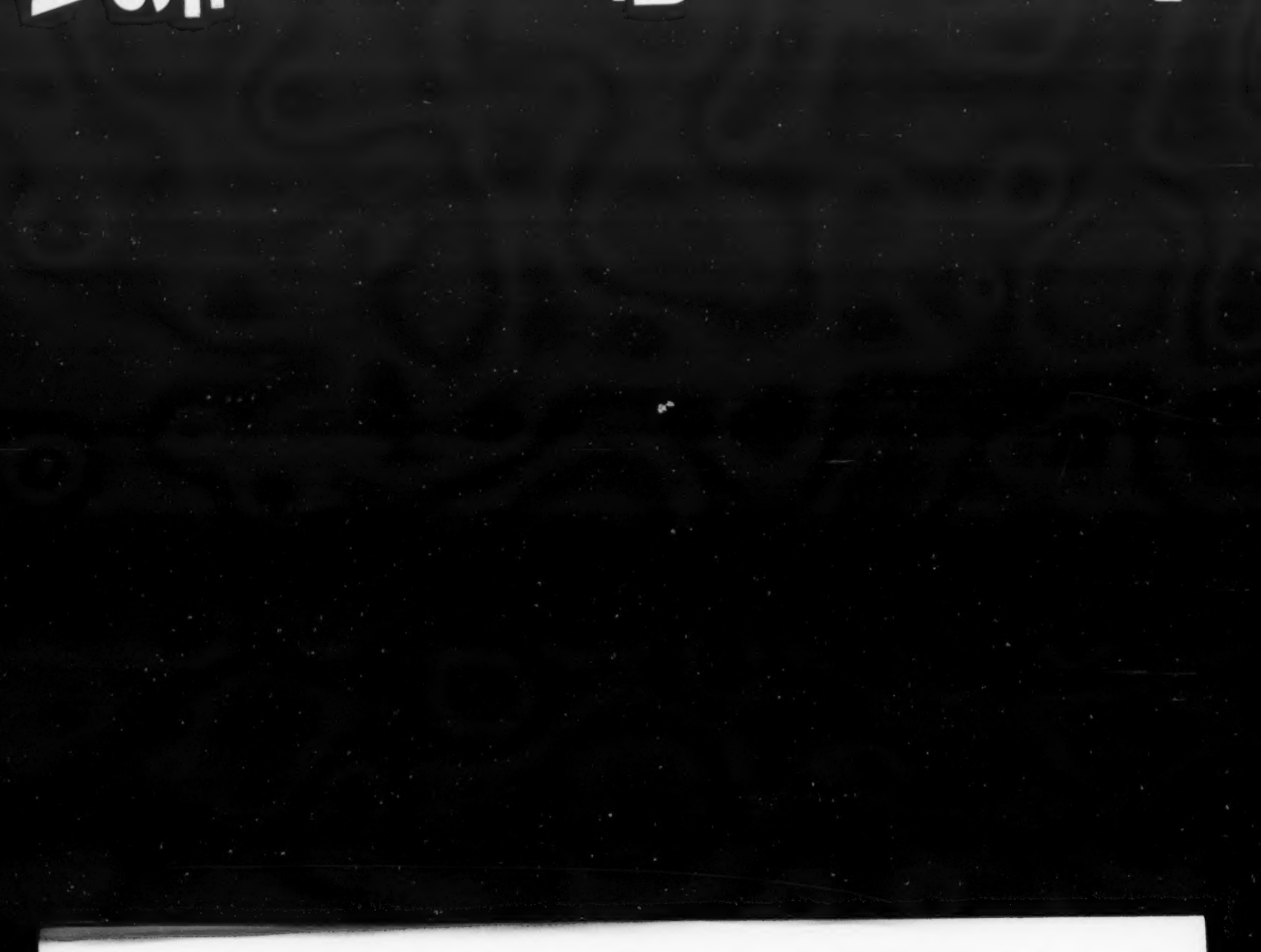
HIS LATE HIGHNESS MAHARAJA
SRI KRISHNARAJA WADIYAR BAHADUR, G.C.S.I., G.B.E.
MYSORE
(4TH JUNE 1884 — 3RD AUGUST 1940)